THE SAE JOURNAL

INDEX

JANUARY THROUGH DECEMBER 1967—VOL 75

Index of 1967 SAE Journal Articles

The Index of 1967 SAE Journal articles printed on these green pages is designed to make each moment you spend looking for information as productive as possible. The final objective is that you go back and read only articles that actually bear on your problem.

Here is the way to use the Index:

- Look up the subject heading of interest.
- Select all the titles under each subject heading that are of specific interest. Note the 6-digit number to the right of each title.
- In the Abstracts Section, which follows the Index, look up the selected Abstracts by means of the 6-digit numbers. (Abstracts are in numerical order.)
- Look up all the articles that the comprehensive Abstracts show should have information of use to you. (Each article can be located by means of the code number to the left of the 6-digit number in the Index. For example, JL67-9-47 means: SAE Journal, 1967, September, article starts on p. 47.)

This Index thus gives you two stages of prescreening before you start pulling old issues. In a way it is like making changes in the design stage of a product, rather than during production.

At each step of the way, the Index is tailored to help you find information rapidly and efficiently. First, the subject headings used are those agreed upon by 14 technical societies in an Engineers Joint Council project to simplify interdisciplinary terminology and indexing. As part of this approach, each article is indexed, on the average, under three to five headings.

In addition, you will note that your chances of finding the articles you need in the 1967 Journal Index are greatly increased because of the inclusion of cross-index headings. Most of these are more general terms, which are designed to lead you to more specific terms, which might cover articles of direct interest to you. Two types of cross-index headings are used:

- "See" is used to relate broad concepts—under which there are no entries—to more specific terms under which entries will be found. For example:

Fuels
see:
Aviation Fuels
Diesel Fuels
Gasoline
Hydrocarbon Fuels
Jet Fuels
Liquefied Petroleum Gases
Liquid Propellants
Military Fuel Supplies

- "See also" is used to relate broad concepts—under which are listed only very general papers on the subject—to the specific terms under which entries will be found. For example:

Design
see also:
Bus Design
Construction Equipment Design
Passenger Car Design
Truck Design
Vehicle Design

An expanded title is used for each article under the subject headings. This helps in your first stage of prescreening, since the expanded title is really a very short Abstract. If you are looking only for background information in a new field, chances are you won't have to go beyond this point to find the articles you want.

Note that the inclusion of an Abstract for each technical article printed in SAE Journal during 1967 is a depth service that allows careful selection without your ever having to leave the green pages.

An Author Index is also included in these green pages so that you can find what articles have been contributed by a particular author.

SAE JOURNAL SUBJECT INDEX

SAE JOURNAL—JANUARY THROUGH DECEMBER, 1967—VOL 75

A

Ablation

Structural design of reusable horizontal-launch vehicles for manned orbital operations system
JL67-11-40 671040

AC Generators
see:
Alternators

Adhesive Bonding

Titanium is being readied for major role in SST design
JL67-6-78 670795

Use of nonmetallic materials–plastics, glass, rubber, organic coatings, and so forth–expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

Aerodynamics

Gas turbines promise profits for off-highway vehicle users
JL67-2-70 670421

Quasi-steady-state data from wind tunnel tests are adequate for analysis of car stability in wind gust conditions up to 15-deg yaw angles
JL67-6-66 670793

Car body aerodynamics play an important role in heater airflow
JL67-9-50 671017

Agricultural Machinery

Shielding is important part of farm machinery safety but other factors are vital, too
JL67-4-88 670768

Change to narrow-row spacing will have modest impact on tractor design and usage
JL67-5-45 670771

A single tractor which executes the farm tasks now performed by a variety of units, and a self-propelled flat-bed farm wagon, is proposed
JL67-9-83 671023

Air Conditioning
See:
Heaters
Ventilation

Air Inlets

Car body aerodynamics play an important role in heater airflow
JL67-9-50 671017

Controls that adjust the variable geometry air inlet of the supersonic transport are vital to successful supersonic flight
JL67-10-54 671031

Air Pollution
See also:
Crankcase Emission
Exhaust Gases

Various component gases of engine generated pollution pose differing health hazards
JL67-3-85 670440

Significant reductions in exhaust emissions can be made by retarding the spark, or by reducing the cylinder quench area
JL67-4-51 670754

Acute pollution problems still face automotive engineers
JL67-11-69 671047

Air Traffic Control

Secondary surveillance radar proves a boon to controlling helicopter traffic near airports
JL67-3-92 670443

Aircraft
see:
Business Aircraft
Helicopters
STOL Aircraft
Supersonic Transports
VTOL Aircraft

Aircraft Equipment

Constant-speed-drive generating systems keep pace with aircraft
JL67-2-48 670416

Self-rectifying automotive-type alternators save weight, reduce expense, simplify controls, give more output at lower speeds on light aircraft
JL67-4-72 670762

Oxygen cylinders may pass out of the picture in favor of newer methods of oxygen storage and distribution in aircraft
JL67-5-50 670774

Pilots not qualified to fly with instruments perform well in light aircraft if they use a wings-leveling device in instrument weather
JL67-5-82 670786

Aircraft Instruments

Adapting electroluminescent lighting to Apollo instrument panel posed problems of lamp brightness and color and high temperature
JL67-8-51 671003

Aircraft Maintenance

Goal of in-service development is more and faster repair to extend jet-engine component life and reduce maintenance cost
JL67-6-62 670791

Techniques planned to minimize time required on Boeing supersonic transport for unscheduled maintenance
JL67-7-46 670987

Aircraft Operation /Aircraft Performance/

Four possible parking arrangements for the Boeing SST
JL67-11-50 671043

Aircraft Reliability

Gap between achieved life and design life of gas turbine components can be narrowed. Practical approach can bring large cost savings
JL67-2-94 670428

Aircraft Structures

Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Aircraft Vibration

Simple, light muffler with low back pressure cuts noise in light aircraft
JL67-5-58 670777

Aircraft Wings
see:
Wings /Aircraft/

Airline Operations
see also:
Air Traffic Control

Operation of aircraft under instrument flying rules at all times would practically eliminate navigational accidents
JL67-12-86 671059

Airports
see also:
Runways

Flight operations from a circular runway are feasible
JL67-3-56 670432

Noise annoyance of new, larger capacity DC-8 jets should be less, due to lower noise level, fewer exposures to noise, reduced duration of noise
JL67-6-51 670788

Satellite concept of superairport separates aircraft from ground operations. Rapid transit system eliminates distance restrictions
JL67-6-82 670797

Proposed assisted take-off and landing system may make in-city airports a reality
JL67-8-39 670999

Alloy Steels

Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Alternators

Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Self-rectifying automotive-type alternators save weight, reduce expense, simplify controls, give more output at lower speeds on light aircraft
JL67-4-72 670762

Aluminum Alloys

Cathodic and anodic actions affect CASS test response of anodized aluminum
JL67-4-75 670763

Ammonia

Ammonia and hydrocarbons theoretically compared as turbine fuels on basis of power output, thermal efficiency, and fuel economy
JL67-6-71 670794

Anodic Coatings

Cathodic and anodic actions affect CASS test response of anodized aluminum
JL67-4-75 670763

Antiknock Rating

Engine tests show that red lead oxide with distorted tetragonal structure is most active antiknock of tel decomposition products
JL67-8-55 671004

Apollo Project

In next ten years, either direct or rendezvous mode will be used for each moon-mission. Rendezvous type costs more but can carry more men
JL67-4-38 670752

Adapting electroluminescent lighting to Apollo instrument panel posed problems of lamp brightness and color and high temperature
JL67-8-51 671003

Assembling

New optical instrument reduces setup times of jig structures and increases accuracy in establishing three mutually perpendicular lines of sight
JL67-4-86 670767

Pontiac uses four parallel lines with manual and automatic stations intermixed to improve quality and reduce manpower in the assembly of differential units
JL67-5-48 670773

Assisted Take-Off and Landing

Proposed assisted take-off and landing system may make in-city airports a reality
JL67-8-39 670999

Atlas Launch Vehicles

Bending moment on Atlas booster tank is increased 50% after wrinkling first occurs in this large thin-walled cylinder
JL67-12-60 671052

Attitude Control

Partial-lifting system is optimal control system for large V/STOL transports
JL67-1-54 670412

Automatic stability augmentation system integral with Boeing H-46 flight control system ensures good stability without an autopilot
JL67-10-64 671034

Automatic Control

Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

Controls that adjust the variable geometry air inlet of the supersonic transport are vital to successful supersonic flight
JL67-10-54 671031

Automatic Transmissions

1967 European cars show changing trends
JL67-2-36 670415

400-bhp engines will be common on trucks in five years, and matching transmissions to them may be more difficult than before
JL67-8-43 671000

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Aviation Fuels
see also:
Jet Fuels

Four factors affect aircraft spark-plug operation
JL67-4-80 670765

Axles

Change to narrow-row spacing will have modest impact on tractor design and usage
JL67-5-45 670771

B

Batteries

Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Through partition cell connector increases battery starting power
JL67-4-68 670760

Gaining better performance for smaller batteries
JL67-5-75 670782

Bearings

Simple procedure sets end play in tapered bearings. It is suitable for assembly line or field service use, and requires only common tools
JL67-4-78 670764

Calculated main bearing forces in multicylinder engines are closer to those measured in tests when crankshaft is assumed elastically supported
JL67-11-76 671049

Blowers
see:
Fans /Blowers/

Boats
see:
Marine Engines

Bodies

Computers speed body engineering
JL67-6-56 670789

Rohm & Haas Explorer IV car demonstrates new automotive uses for acrylics
JL67-6-64 670792

Computer defines and shapes complex surfaces. A complete but simplified car body has been designed and displayed in three dimensions
JL67-7-66 670995

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Bolts

Occasional overloads cause bolt loosening
JL67-8-64 671006

Bonding
see:
Adhesive Bonding
Welding

Brakes
see also:
Disc Brakes
Retarders

1967 European cars show changing trends
JL67-2-36 670415

Systems analysis is used to develop prototype design of New York State Safety Car
JL67-3-36 670429

World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

Japanese National Railroads and Pennsylvania is getting a high-speed electric train with self-propelled railcars
JL67-8-74 671009

Brake response in passenger cars and trucks improves when brake proportioning valves adjust brakes for dynamic and static loading
JL67-9-58 671019

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Brayton Cycle

Ammonia and hydrocarbons theoretically compared as turbine fuels on basis of power output, thermal efficiency, and fuel economy
JL67-6-71 670794

Bus Design

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Business Aircraft

Business jet service life is being lengthened with a combination of film and convection cooling for turbine stator and rotor blades
JL67-12-78 671056

C

Carbon Steels

Five new carbon steels have been inserted between SAE 1026 and 1027 to fill the gap in hardenability range
JL67-4-84 670766

Carburetors /Carburetion/

1967 European cars show changing trends
JL67-2-36 670415

Carburetors having means to compensate for inlet air pressure and temperature variations would reduce air pollution
JL67-5-42 670770

Throttle is only moving part in low-cost fluidic carburetor
JL67-8-36 670998

Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Cast Iron

Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Casting

Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Chromium Alloys

Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Coating

see:
Anodic Coatings
Paints
Protective Coatings

Cobalt Alloys

Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Cockpits

Restraint systems promise substantial crash protection
JL67-4-58 670758

Cold Weather Operation

Fuel fired heater provides instant interior warmth and warmer cold starting
JL67-3-98 670445

Combustion

see also:
Knock
Preignition

Nitrogen oxides found in spark-ignition engine exhaust are flame-formed
JL67-7-52 670991

Corrosion and radiation effects must be minimized in fuels for automotive turbine engines
JL67-7-69 670996

Combustion Chambers

Engine deposits, expressed in terms of thermal resistance and penetration, showed their adverse effects on performance in laboratory tests
JL67-2-82 670424

Effect of cylinder and exhaust system modifications on the performance of 2-stroke-cycle engines
JL67-4-43 670753

Significant reductions in exhaust emissions can be made by retarding the spark, or by reducing the cylinder quench area
JL67-4-51 670754

Communication Systems

Unified communication system promises safer driving
JL67-5-36 670769

Ford and Bureau of Public Roads are developing systems to improve vehicular communications on the highway
JL67-12-73 671054

Compressors

Diesel cylinder design is not compromised when certain cylinders are used as air compressors to unload bulk cargo
JL67-9-55 671018

Computer Applications

Chrysler uses computer data processing to record history of each car, pay legitimate claims, and follow up on questionable ones
JL67-2-77 670422

Computer Simulation

Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Computer defines and shapes complex surfaces. A complete but simplified car body has been designed and displayed in three dimensions
JL67-7-66 670995

Increased design complexity yields to automated design with aid of digital computer
JL67-10-43 671026

Connectors

see:
Linkages

Construction Equipment Design

see also:
Tractor Scrapers

An engineer from Viet Nam tells about the hydraulic system problems that come from neglecting small things, and failures due to poor quality control
JL67-1-47 670409

Gas turbines promise profits for off-highway vehicle users
JL67-2-70 670421

Future tractor and earthmover aim for increased productivity
JL67-9-90 671024

Hydraulic skooper dump cylinder failures due to surge pressure and mechanical bumping are eliminated by cylinder with an external cushion
JL67-10-69 671035

Contamination

see:
Air Pollution

Control Systems
see:
Air Traffic Control
Attitude Control
Automatic Control
Electric Control /Electronic/
Flight Control
Fuel Control
Numerical Control
Production Control
Propulsion System Controls
Quality Control
Thrust Vector Control

Cooling
see:
Ablation
Engine Cooling

Cooling Systems
Vapor pressure comparator will operate satisfactorily under abnormal conditions
JL67-5-80 670785

Corrosion
Fuel factors producing corrosion can be identified and corrosion life of valve alloys measured by drilled-hole engine-mounted test
JL67-1-43 670408

Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Corrosion and radiation effects must be minimized in fuels for automotive turbine engines
JL67-7-69 670996

Aircraft hydraulic parts survive jungle erosive environment. O-rings still pliable and functional
JL67-9-40 671013

Corrosion Prevention
Tailoring the truck cooling system to new engine requirements can pay dividends in increased vehicle reliability and life
JL67-1-62 670414

Laboratory antirust oil test results checked in 4000 miles of field testing
JL67-3-81 670439

Crankcase Emission
1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Crankcase Oils
Laboratory antirust oil test results checked in 4000 miles of field testing
JL67-3-81 670439

Cleaner engines and improved fleet availability follow switch from conventional to long-life oils in Montreal police car fleet
JL67-5-46 670772

Tests on four compact cars prove that lowering oil viscosity and increasing fuel vapor pressure ease cold starting problems
JL67-10-62 671033

Crankshafts
Two V-8 engine crankshafts fitted to central drive gear form crankshaft for Coventry Climax Flat-16 engine
JL67-11-49 671042

Calculated main bearing forces in multicylinder engines are closer to those measured in tests when crankshaft is assumed elastically supported
JL67-11-76 671049

Crash Research
Restraint systems promise substantial crash protection
JL67-4-58 670758

Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Cryogenics
Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Cylinders
see also:
Combustion Chambers
Hydraulic skooper dump cylinder failures due to surge pressure and mechanical bumping are eliminated by cylinder with an external cushion
JL67-10-69 671035

Bending moment on Atlas booster tank is increased 50% after wrinkling first occurs in this large thin-walled cylinder
JL67-12-60 671052

D

Data Processing
Chrysler uses computer data processing to record history of each car, pay legitimate claims, and follow up on questionable ones
JL67-2-77 670422

Design
see also:
Bus Design
Construction Equipment Design
Passenger Car Design
Truck Design
Vehicle Design

Computer defines and shapes complex surfaces. A complete but simplified car body has been designed and displayed in three dimensions
JL67-7-66 670995

Increased design complexity yields to automated design with aid of digital computer
JL67-10-43 671026

Dies
Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Diesel Engines
see also:
Two Stroke Cycle Engines
Variable Compression Ratio Engines

Gas turbines promise profits for off-highway vehicle users
JL67-2-70 670421

Diesels must lose weight to find marine powerplant usage. Research continues to satisfy Coast Guard needs
JL67-5-78 670784

400-bhp engines will be common on trucks in five years, and matching transmissions to them may be more difficult than before
JL67-8-43 671000

Otto- and diesel-cycle-engines will remain dominant mobile powerplants in next 10-25 years; later, fuel cell and battery will emerge
JL67-8-60 671005

Diesel cylinder design is not compromised when certain cylinders are used as air compressors to unload bulk cargo
JL67-9-55 671018

Calculated main bearing forces in multicylinder engines are closer to those measured in tests when crankshaft is assumed elastically supported
JL67-11-76 671049

Diesel Fuels
Fuel factors producing corrosion can be identified and corrosion life of valve alloys measured by drilled-hole engine-mounted test
JL67-1-43 670408

Differential Gears
Pontiac uses four parallel lines with manual and automatic stations intermixed to improve quality and reduce manpower in the assembly of differential units
JL67-5-48 670773

Disc Brakes
1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Drilling
Titanium is being readied for major role in SST design
JL67-6-78 670795

Driveshafts
Two V-8 engine crankshafts fitted to central drive gear form crankshaft for Coventry Climax Flat-16 engine
JL67-11-49 671042

Dynamometers
Large chassis dynamometer tests of tractor-trailer reveal ways to improve tractor-cab ride
JL67-3-60 670433

E

Education
Self-motivation is key element in continuing education success
JL67-2-80 670423

Manufacturing problems call for engineering professionals
JL67-4-52 670755

Review of Interim Report of Committee on Goals of Engineering Education indicates its chances of widespread acceptance are good
JL67-10-60 671032

Elastomers
see:
Rubber /Synthetic Rubber/

Electric Control /Electronic/
Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

Unified communication system promises safer driving
JL67-5-36 670769

D-c variable-speed motor has superior performance, decreased size and cost. Initial use is as windshield wiper motor
JL67-5-76 670783

Electric Drives
World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Electric Equipment /Electronic/
Constant-speed-drive generating systems keep pace with aircraft
JL67-2-48 670416

Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Moisture-proofing car window lift motors
JL67-3-96 670444

D-c variable-speed motor has superior performance, decreased size and cost. Initial use is as windshield wiper motor
JL67-5-76 670783

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Electroluminescence
Adapting electroluminescent lighting to Apollo instrument panel posed problems of lamp brightness and color and high temperature
JL67-8-51 671003

Energy Conversion
Otto- and diesel-cycle-engines will remain dominant mobile powerplants in next 10-25 years; later, fuel cell and battery will emerge
JL67-8-60 671005

Engine Cooling
Tailoring the truck cooling system to new engine requirements can pay dividends in increased vehicle reliability and life
JL67-1-62 670414

Test rig measures heat transfer of various piston cooling methods
JL67-9-47 671015

Business jet service life is being lengthened with a combination of film and convection cooling for turbine stator and rotor blades
JL67-12-78 671056

Engine Deposits
Engine deposits, expressed in terms of thermal resistance and penetration, showed their adverse effects on performance in laboratory tests
JL67-2-82 670424

Four factors affect aircraft spark-plug operation
JL67-4-80 670765

Reducing the oil concentration in fuel for 2-stroke-cycle engines has marked advantages, but careful formulation of the oil is necessary
JL67-6-59 670790

Corrosion and radiation effects must be minimized in fuels for automotive turbine engines
JL67-7-69 670996

Engine Mounting
Techniques planned to minimize time required on Boeing supersonic transport for unscheduled maintenance
JL67-7-46 670987

Engine Oils
see:
Crankcase Oils

Engines
see:
Diesel Engines
Energy Conversion
Marine Engines
Racing Engines
Small Engines
Spark Ignition Engines
Stratified Charge Engines
Turbine Engines
Turbofan Engines
Turbojet Engines
Turboshaft Engines
Two Stroke Cycle Engines
Variable Compression Ratio Engines
Wankel Rotating Combustion Engine

Engineers
see also:
Education

The engineer who would equip himself to be an effective supervisor must: help prepare and use budget information
JL67-1-53 670411

Eight steps to successful decisionmaking
JL67-1-60 670413

The engineer who would equip himself to be an effective supervisor must: utilize manpower efficiently
JL67-2-69 670420

Self-motivation is key element in continuing education success
JL67-2-80 670423

Value engineering pays off. Two-word problem definitions and placing monetary values on performance are essentials
JL67-2-84 670425

The engineer who would equip himself to be an effective supervisor must: evaluate employee performance and qualifications
JL67-3-91 670442

Manufacturing problems call for engineering professionals
JL67-4-52 670755

The engineer who would equip himself to be an effective supervisor must: make salary and promotion recommendations
JL67-4-56 670757

Myths about engineers block individual progress
JL67-4-71 670761

The engineer who would equip himself to be an effective supervisor must: serve as a communication link
JL67-5-65 670779

The engineer who would equip himself to be an effective supervisor must: counsel with employees
JL67-6-88 670798

The engineer who would equip himself to

be an effective supervisor must: encourage employee development
JL67-7-47 670988

The engineer who would equip himself to be an effective supervisor must: develop skill in conducting meetings
JL67-8-45 671001

The engineer who would equip himself to be an effective supervisor must: administer policies and procedures
JL67-9-49 671016

Ground rules for success as a manager
JL67-10-44 671027

Car occupant restraint system should require no overt action by user
JL67-10-45 671028

The engineer who would equip himself to be an effective supervisor must: maintain morale and motivation
JL67-10-53 671030

Review of Interim Report of Committee on Goals of Engineering Education indicates its chances of widespread acceptance are good
JL67-10-60 671032

Exhaust Gases

Various component gases of engine generated pollution pose differing health hazards
JL67-3-85 670440

Significant reductions in exhaust emissions can be made by retarding the spark, or by reducing the cylinder quench area
JL67-4-51 670754

Carburetors having means to compensate for inlet air pressure and temperature variations would reduce air pollution
JL67-5-42 670770

Nitrogen oxides found in spark-ignition engine exhaust are flame-formed
JL67-7-52 670991

Smoke and smell reduction are major diesel exhaust problems
JL67-9-34 671011

Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Concentration shifts of the total or a particular exhaust emission may not reflect, even in direction, concentration shifts of other emission constituents
JL67-11-58 671045

Acute pollution problems still face automotive engineers
JL67-11-69 671047

Exhaust Systems

Effect of cylinder and exhaust system modifications on the performance of 2-stroke-cycle engines
JL67-4-43 670753

Simple, light muffler with low back pressure cuts noise in light aircraft
JL67-5-58 670777

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

F

Failure

Hydraulic skooper dump cylinder failures due to surge pressure and mechanical bumping are eliminated by cylinder with an external cushion
JL67-10-69 671035

Fan /Blowers/

Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Fasteners

see:
Bolts

Fatigue

Six guidelines to help engineers design highway truck tractor frames
JL67-2-50 670417

Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Occasional overloads cause bolt loosening
JL67-8-64 671006

Fiber Optics

Plastic fiber optics materials are being used in various lighting and remote-indicating systems on some of the 1967 cars
JL67-12-67 671053

Field Tests

Cleaner engines and improved fleet availability follow switch from conventional to long-life oils in Montreal police car fleet
JL67-5-46 670772

Fire Prevention

Titanium is being readied for major role in SST design
JL67-6-78 670795

Fleet Operation

Cleaner engines and improved fleet availability follow switch from conventional to long-life oils in Montreal police car fleet
JL67-5-46 670772

Flight Control

Partial-lifting system is optimal control system for large V/STOL transports
JL67-1-54 670412

Automatic stability augmentation system integral with Boeing H-46 flight control system ensures good stability without an autopilot
JL67-10-64 671034

Fluid Systems

Throttle is only moving part in low-cost fluidic carburetor
JL67-8-36 670998

Frames

Six guidelines to help engineers design highway truck tractor frames
JL67-2-50 670417

Systems analysis is used to develop prototype design of New York State Safety Car
JL67-3-36 670429

World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Friction

Unified theory of rubber friction reveals role of adhesion component in tire-road surface coupling
JL67-8-70 671008

Friction Materials

Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

Use of nonmetallic materials–plastics, glass, rubber, organic coatings, and so forth–expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

Fuel Additives

Engine tests show that red lead oxide with distorted tetragonal structure is most active antiknock of tel decomposition products
JL67-8-55 671004

Fuel Cells

Otto- and diesel-cycle-engines will remain dominant mobile powerplants in next 10–25 years; later, fuel cell and battery will emerge
JL67-8-60 671005

Fuel Consumption

Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

Carburetors having means to compensate for inlet air pressure and temperature variations would reduce air pollution
JL67-5-42 670770

Ammonia and hydrocarbons theoretically compared as turbine fuels on basis of power output, thermal efficiency, and fuel economy
JL67-6-71 670794

Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Fuel Control
Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

Fuel Injection
Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

1967 European cars show changing trends
JL67-2-36 670415

Jeep engine gets stratified charge combustion
JL67-4-63 670759

Corrosion and radiation effects must be minimized in fuels for automotive turbine engines
JL67-7-69 670996

It is the small power gains that win Grand Prix races
JL67-10-72 671036

Early Coventry engines were losing races due to oil churning, overheating, ignition failure, and fuel blockage, rather than lack of power
JL67-12-84 671058

Fuel Systems
see also:
Carburetors /Carburetion/
Fuel Injection

Aircraft hydraulic parts survive jungle erosive environment. O-rings still pliable and functional
JL67-9-40 671013

Fuels
see:
Aviation Fuels
Diesel Fuels
Gasoline
Hydrocarbon Fuels
Jet Fuels
Liquefied Petroleum Gases
Liquid Propellants
Military Fuel Supplies

G

Gasoline
Tests on four compact cars prove that lowering oil viscosity and increasing fuel vapor pressure ease cold starting problems
JL67-10-62 671033

Gasoline Engines
1967 European cars show changing trends
JL67-2-36 670415

Significant reductions in exhaust emissions can be made by retarding the spark, or by reducing the cylinder quench area
JL67-4-51 670754

Chevrolet's V-8 "Turbo-Jet" passenger car engine was designed primarily to increase volumetric efficiency
JL67-8-66 671007

Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Gears
see:
Differential Gears

Glass
Use of nonmetallic materials–plastics, glass, rubber, organic coatings, and so forth–expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Glass Fibers
Three new glass-reinforced plastics are available in sheet form, ready for molding. Matched-die molding operations can be used
JL67-12-80 671057

Ground Effect Machines
French Aerotrain, which rides on air cushion, and jet-powered New York Central train have gone over 180 mph
JL67-7-74 670997

Ground Support Equipment
Fourteen elements are significant in customer attitude on ground support equipment
JL67-6-80 670796

Shock, vibration, ride dynamics and suspension are main factors in ground missile-carrier design
JL67-7-56 670993

H

Hardenability
Five new carbon steels have been inserted between SAE 1026 and 1027 to fill the gap in hardenability range
JL67-4-84 670766

Headlamps
Different intensity day and night turn signals, improved headlight low beam for turnpike driving stir attention in Europe
JL67-11-36 671039

Heat Exchangers
see:
Spacecraft Radiators

Heat Resistant Materials
see also:
Refractory Metals

Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Protective coatings help to extend jet engine part life
JL67-3-78 670438

Best electrical materials for use between 600 and 1600 F are studied
JL67-6-89 670799

Heat Transfer
Test rig measures heat transfer of various piston cooling methods
JL67-9-47 671015

Heaters
Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Fuel fired heater provides instant interior warmth and warmer cold starting
JL67-3-98 670445

Car body aerodynamics play an important role in heater airflow
JL67-9-50 671017

Helicopters
Secondary surveillance radar proves a boon to controlling helicopter traffic near airports
JL67-3-92 670443

Automatic stability augmentation system integral with Boeing H-46 flight control system ensures good stability without an autopilot
JL67-10-64 671034

Hot Forming
Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Hydraulic Systems
An engineer from Viet Nam tells about the hydraulic system problems that come from neglecting small things, and failures due to poor quality control
JL67-1-47 670409

New remote controlled valve simplifies vehicle hydraulic systems
JL67-3-63 670434

Aircraft hydraulic parts survive jungle erosive environment. O-rings still pliable and functional
JL67-9-40 671013

Demand valve switches flow from steering to implement circuits in articulated vehicle
JL67-9-42 671014

Automatic stability augmentation system integral with Boeing H-46 flight control system ensures good stability without an autopilot
JL67-10-64 671034

Hydraulic skooper dump cylinder failures due to surge pressure and mechanical bumping are eliminated by cylinder with an external cushion
JL67-10-69 671035

Hydrocarbon Fuels

Ammonia and hydrocarbons theoretically compared as turbine fuels on basis of power output, thermal efficiency, and fuel economy
JL67-6-71 670794

I

Ignition Systems
see also:
Spark Plugs

Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

Early Coventry engines were losing races due to oil churning, overheating, ignition failure, and fuel blockage, rather than lack of power
JL67-12-84 671058

Impact Tests

Penetrating study of meteoroid barriers for spacecraft
JL67-5-68 670781

Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Industrial Equipment

Gas turbines promise profits for off-highway vehicle users
JL67-2-70 670421

Inspection
see also:
Quality Control
Radiography
X-Ray Inspection

Titanium is being readied for major role in SST design
JL67-6-78 670795

Instrument Flight

Secondary surveillance radar proves a boon to controlling helicopter traffic near airports
JL67-3-92 670443

Operation of aircraft under instrument flying rules at all times would practically eliminate navigational accidents
JL67-12-86 671059

Instruments
see also:
Aircraft Instruments
Dynamometers
Smokemeters

New optical instrument reduces setup times of jig structures and increases accuracy in establishing three mutually perpendicular lines of sight
JL67-4-86 670767

Insulation

Best electrical materials for use between 600 and 1600 F are studied
JL67-6-89 670799

Iron
see:
Cast Iron

J

Jet Aircraft Operation

Jet engine in high-speed stall can stall other engines in cluster
JL67-3-48 670430

A seating capacity of 500 will be needed to produce a 20% drop in direct operating costs, compared with today's large jets
JL67-3-70 670436

Noise annoyance of new, larger capacity DC-8 jets should be less, due to lower noise level, fewer exposures to noise, reduced duration of noise
JL67-6-51 670788

Jet Fuels

Thermal stability of jet fuel can be maintained from refinery to aircraft
JL67-7-48 670989

Corrosion and radiation effects must be minimized in fuels for automotive turbine engines
JL67-7-69 670996

K

Kinematics

Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Increased design complexity yields to automated design with aid of digital computer
JL67-10-43 671026

Knock

Engine deposits, expressed in terms of thermal resistance and penetration, showed their adverse effects on performance in laboratory tests
JL67-2-82 670424

Engine tests show that red lead oxide with distorted tetragonal structure is most active antiknock of tel decomposition products
JL67-8-55 671004

L

Launch Vehicles
see also:
Atlas Launch Vehicles

Three Titan III launch vehicles are versatile space performers
JL67-6-84 670206

Saturn IB launch vehicle can be uprated to handle missions of the future
JL67-9-76 671022

Structural design of reusable horizontal-launch vehicles for manned orbital operations system
JL67-11-40 671040

Launching Sites

Three Titan III launch vehicles are versatile space performers
JL67-6-84 670206

Leakage

Car body aerodynamics play an important role in heater airflow
JL67-9-50 671017

Legislation

Acute pollution problems still face automotive engineers
JL67-11-69 671047

Lighting
see also:
Headlamps

Adapting electroluminescent lighting to Apollo instrument panel posed problems of lamp brightness and color and high temperature
JL67-8-51 671003

Different intensity day and night turn signals, improved headlight low beam for turnpike driving stir attention in Europe
JL67-11-36 671039

Plastic fiber optics materials are being used in various lighting and remote-indicating systems on some of the 1967 cars
JL67-12-67 671053

Linkages

Computers speed body engineering
JL67-6-56 670789

Liquefied Petroleum Gases

Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Liquid Propellants

New Navy monopropellant simplifies tor-

pedo propulsion, handles safely
JL67-5-61 670778

Low Temperature Starting

Fuel fired heater provides instant interior warmth and warmer cold starting
JL67-3-98 670445

Tests on four compact cars prove that lowering oil viscosity and increasing fuel vapor pressure ease cold starting problems
JL67-10-62 671033

Lubricants

see also:
Crankcase Oils
Oil Additives

New apparatus measures friction characteristics of controlled-slip differential lubricants
JL67-9-66 671020

Lubrication

Reducing the oil concentration in fuel for 2-stroke-cycle engines has marked advantages, but careful formulation of the oil is necessary
JL67-6-59 670790

Lunar Vehicles

In next ten years, either direct or rendezvous mode will be used for each moon-mission. Rendezvous type costs more but can carry more men
JL67-4-38 670752

M

Machining

Titanium is being readied for major role in SST design
JL67-6-78 670795

Magnetic pulse forming occurs under the pressure produced by the interaction of a magnetic field and the currents it induces in a workpiece
JL67-7-54 670992

Magnetic Forming

Magnetic pulse forming occurs under the pressure produced by the interaction of a magnetic field and the currents it induces in a workpiece
JL67-7-54 670992

Magnetic Materials

Best electrical materials for use between 600 and 1600 F are studied
JL67-6-89 670799

Maintainability

An engineer from Viet Nam tells about the hydraulic system problems that come from neglecting small things, and failures due to poor quality control
JL67-1-47 670409

Maintenance

see:
Aircraft Maintenance
Fleet Operation

Management

Ground rules for success as a manager
JL67-10-44 671027

Management Planning

see:
Value Engineering

Manikins

Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Manipulators

New concept joins man and machine to perform gigantic tasks. Application will be to earthmoving and materials handling
JL67-9-72 671021

Manual Transmissions

400-bhp engines will be common on trucks in five years, and matching transmissions to them may be more difficult than before
JL67-8-43 671000

Manufacturing

Improved reporting is giving top management the brief, factual, financially oriented information needed to make sound decisions promptly
JL67-3-88 670441

Manufacturing problems call for engineering professionals
JL67-4-52 670755

Marine Engines

Diesels must lose weight to find marine powerplant usage. Research continues to satisfy Coast Guard needs
JL67-5-78 670784

Materials Handling

New concept joins man and machine to perform gigantic tasks. Application will be to earthmoving and materials handling
JL67-9-72 671021

Metal Forming

see also:
Casting
Hot Forming
Magnetic Forming

Stretch-forming preformed sleeves into parts saves materials. Equipment and tooling costs compare favorably with those for metal drawing
JL67-3-54 670431

Military Equipment

An engineer from Vietnam tells about the hydraulic system problems that come from neglecting small things, and failures due to poor quality control
JL67-1-47 670409

Military Fuel Supplies

New Navy monopropellant simplifies torpedo propulsion, handles safely
JL67-5-61 670778

Military Transportation

New concept joins man and machine to perform gigantic tasks. Application will be to earthmoving and materials handling
JL67-9-72 671021

Military Vehicle Mobility

Four Army vehicles–drum, drum-belt, track, and track-pontoon–which have been designed to traverse soft soil and watery areas, show promise under test
JL67-7-50 670990

Shock, vibration, ride dynamics and suspension are main factors in ground missile-carrier design
JL67-7-56 670993

Mobility Research

Four army vehicles–drum, drum-belt, track, and track-pontoon–which have been designed to traverse soft soil and watery areas, show promise under test
JL67-7-50 670990

Mounts

Dynamic versus static spring rates for vibration mounts. Dynamic spring rate dependent on four variables. Two dynamic test methods described
JL67-11-80 671050

Mufflers

Simple, light muffler with low back pressure cuts noise in light aircraft
JL67-5-58 670777

N

NASA Space Program

see also:
Apollo Project

Government technology stockpile is now one of country's valuable resources. Practical ways are being focused to make data available to industry
JL67-9-38 671012

Nickel Alloys

Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Niobium Alloys

New protective coatings allow use of columbium and tantalum alloys in reusable reentry vehicles despite their poor oxidation resistance
JL67-10-46 671029

Noise

Simple, light muffler with low back pressure cuts noise in light aircraft
JL67-5-58 670777

Noise annoyance of new, larger capacity DC-8 jets should be less, due to lower noise level, fewer exposures to noise, reduced duration of noise
JL67-6-51 670788

Nondestructive Testing

see:
Radiography
X-Ray Inspection

Numerical Control

Computers speed body engineering
JL67-6-56 670789

O

Octane Number

see:
Antiknock Rating
Knock

Oil Additives

Laboratory antirust oil test results checked in 4000 miles of field testing
JL67-3-81 670439

Cleaner engines and improved fleet availability follow switch from conventional to long-life oils in Montreal police car fleet
JL67-5-46 670772

Operating Costs

A seating capacity of 500 will be needed to produce a 20% drop in direct operating costs, compared with today's large jets
JL67-3-70 670436

Oxygen

Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Oxygen cylinders may pass out of the picture in favor of newer methods of oxygen storage and distribution in aircraft
JL67-5-50 670774

P

Packaging

An engineer from Viet Nam tells about the hydraulic system problems that come from neglecting small things, and failures due to poor quality control
JL67-1-47 670409

Paints

Use of nonmetallic materials–plastics, glass, rubber, organic coatings, and so forth–expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

Passenger Car Design

1967 European cars show changing trends
JL67-2-36 670415

Systems analysis is used to develop prototype design of New York State Safety Car
JL67-3-36 670429

Pistons /Piston Rings/

Effect of cylinder and exhaust system modifications on the performance of 2-stroke-cycle engines
JL67-4-43 670753

Reducing the oil concentration in fuel for 2-stroke-cycle engines has marked advantages, but careful formulation of the oil is necessary
JL67-6-59 670790

Test rig measures heat transfer of various piston cooling methods
JL67-9-47 671015

Plastics

see also:
Reinforced Plastics

Plexiglas H is acrylic plastic for higher temperature service in automotive signal lenses
JL67-2-86 670426

Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Rohm & Haas Explorer IV car demonstrates new automotive uses for acrylics
JL67-6-64 670792

Use of nonmetallic materials–plastics, glass, rubber, organic coatings, and so forth–expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

Plastic fiber optics materials are being used in various lighting and remote-indicating systems on some of the 1967 cars
JL67-12-67 671053

Power Steering

Hydrostatic power steering system opens new era in controllability
JL67-4-54 670756

Power Transmission

see:
Automatic Transmissions
Axles
Crankshafts
Driveshafts
Electric Drives
Manual Transmissions
Transmissions

Powerplant

see:
Diesel Engines
Energy Coaversion
Fuel Cells
Gasoline Engines
Marine Engines
Racing Engines
Small Engines
Spark Ignition Engines
Stratified Charge Engines
Turbine Engines
Turbofan Engines
Turbojet Engines
Turboshaft Engines
Two Stroke Cycle Engines
Variable Compression Ratio Engines
Wankel Rotating Combustion Engine

Preignition

Engine deposits, expressed in terms of thermal resistance and penetration, showed their adverse effects on performance in laboratory tests
JL67-2-82 670424

Production Control

Magnetic pulse forming occurs under the pressure produced by the interaction of a magnetic field and the currents it induces in a workpiece
JL67-7-54 670992

Propellant Tanks

Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Penetrating study of meteoroid barriers for spacecraft
JL67-5-68 670781

Bending moment on Atlas booster tank is increased 50% after wrinkling first occurs in this large thin-walled cylinder
JL67-12-60 671052

Propulsion System Controls

Controls that adjust the variable geometry air inlet of the supersonic transport are vital to successful supersonic flight
JL67-10-54 671031

Protective Coatings

Protective coatings help to extend jet engine part life
JL67-3-78 670438

Cathodic and anodic actions affect CASS test response of anodized aluminum
JL67-4-75 670763

New protective coatings allow use of columbium and tantalum alloys in reusable reentry vehicles despite their poor oxidation resistance
JL67-10-46 671029

Pumps

see:
Fuel Injection

Q

Quality Control

An engineer from Viet Nam tells about the hydraulic system problems that come from neglecting small things, and failures due to poor quality control
JL67-1-47 670409

Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

R

Racing Engines

It is the small power gains that win Grand Prix races
JL67-10-72 671036

Early Coventry engines were losing races due to oil churning, overheating, ignition failure, and fuel blockage, rather than lack of power
JL67-12-84 671058

Radar

Secondary surveillance radar proves a boon to controlling helicopter traffic near airports
JL67-3-92 670443

Radio Equipment

Unified communication system promises safer driving
JL67-5-36 670769

Radiography

Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

Railroads

Rail travel is about to be changed by lightweight, streamlined, high-speed trains designed for passenger comfort
JL67-6-40 670787

French Aerotrain, which rides on air cushion, and jet-powered New York Central train have gone over 180 mph
JL67-7-74 670997

Japanese National Railroads and Pennsylvania is getting a high-speed electric train with self-propelled railcars
JL67-8-74 671009

Rapid Transit

Satellite concept of superairport separates aircraft from ground operations. Rapid transit system eliminates distance restrictions
JL67-6-82 670797

Reentry

New protective coatings allow use of columbium and tantalum alloys in reusable reentry vehicles despite their poor oxidation resistance
JL67-10-46 671029

Refractory Metals

New protective coatings allow use of columbium and tantalum alloys in reusable reentry vehicles despite their poor oxidation resistance
JL67-10-46 671029

Reinforced Plastics

Three new glass-reinforced plastics are available in sheet form, ready for molding. Matched-die molding operations can be used
JL67-12-80 671057

Reliability

see:
Aircraft Reliability

Research

see also:
Crash Research
Mobility Research

Government technology stockpile is now one of country's valuable resources. Practical ways are being focused to make data available to industry
JL67-9-38 671012

Retarders

World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Ride Evaluation

Ride simulator speeds design studies aimed at operator comfort
JL67-5-54 670776

Riding Quality

Large chassis dynamometer tests of tractor-trailer reveal ways to improve tractor-cab ride
JL67-3-60 670433

Shock, vibration, ride dynamics and suspension are main factors in ground missile-carrier design
JL67-7-56 670993

Rubber /Synthetic Rubber

Unified theory of rubber friction reveals role of adhesion component in tire-road surface coupling
JL67-8-70 671008

Use of nonmetallic materials–plastics, glass, rubber, organic coatings, and so forth–expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

Dynamic versus static spring rates for vibration mounts. Dynamic spring rate dependent on four variables. Two dynamic test methods described
JL67-11-80 671050

Runways

Flight operations from a circular runway are feasible
JL67-3-56 670432

Proposed assisted take-off and landing system may make in-city airports a reality
JL67-8-39 670999

S

Safety

see:
Crash Research
Fire Prevention
Seat Belts
Traffic Safety
Vehicle Safety

Scavenging

Techniques for indirect measurement of scavenging parameters show promise for evaluating scavenging efficiency
JL67-11-72 671048

Seals

see also:
Pistons /Piston Rings/

Moisture-proofing car window lift motors
JL67-3-96 670444

Aircraft hydraulic parts survive jungle erosive environment. O-rings still pliable and functional
JL67-9-40 671013

Seat Belts

Systems analysis is used to develop prototype design of New York State Safety Car
JL67-3-36 670429

Restraint systems promise substantial crash protection
JL67-4-58 670758

Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Restraints used in Los Angeles police cars include seat belt and double shoulder straps–plus crash helmets
JL67-8-86 671010

Car occupant restraint system should require no overt action by user
JL67-10-45 671028

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Seats

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Shafts /Power/

see:
Axles
Crankshafts
Driveshafts

Shock

Shock, vibration, ride dynamics and suspension are main factors in ground missile-carrier design
JL67-7-56 670993

Shock Absorbers

Hydraulic skooper dump cylinder failures due to surge pressure and mechanical bumping are eliminated by cylinder with an external cushion
JL67-10-69 671035

Signal Lights

Plexiglas H is acrylic plastic for higher temperature service in automotive signal lenses
JL67-2-86 670426

Two approaches to control of turn signal flasher quality
JL67-3-66 670435

Simulation

see:
Computer Simulation

Simulators

Ride simulator speeds design studies aimed at operator comfort
JL67-5-54 670776

Small Engines

Effect of cylinder and exhaust system modifications on the performance of 2-stroke-cycle engines
JL67-4-43 670753

Smokemeters

Smoke and smell reduction are major diesel exhaust problems
JL67-9-34 671011

Space Environment

Penetrating study of meteoroid barriers for spacecraft
JL67-5-68 670781

Spacecraft

see:
Apollo Project
Lunar Vehicles

Spacecraft Equipment

Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Spacecraft Radiators

Penetrating study of meteoroid barriers for spacecraft
JL67-5-68 670781

Spacecraft Structures

Penetrating study of meteoroid barriers for spacecraft
JL67-5-68 670781

Structural design of reusable horizontal-launch vehicles for manned orbital operations system
JL67-11-40 671040

Spark Ignition Engines

Otto- and diesel-cycle-engines will remain dominant mobile powerplants in next 10–25 years; later, fuel cell and battery will emerge
JL67-8-60 671005

Spark Plugs

Four factors affect aircraft spark-plug operation
JL67-4-80 670765

Reducing the oil concentration in fuel for 2-stroke-cycle engines has marked advantages, but careful formulation of the oil is necessary
JL67-6-59 670790

Sports Cars

1967 European cars show changing trends
JL67-2-36 670415

Stability

Quasi-steady-state data from wind tunnel tests are adquate for analysis of car stability in wind gust conditions up to 15-deg yaw angles
JL67-6-66 670793

Automatic stability augmentation system integral with Boeing H-46 flight control system ensures good stability without an autopilot
JL67-10-64 671034

Stainless Steels

Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Statistics

see:
Quality Control

Steels

see:
Alloy Steels
Carbon Steels
Stainless Steels

Steering

see also:
Power Steering

Demand valve switches flow from steering to implement circuits in articulated vehicle
JL67-9-42 671014

Driver's chances of survival in head-on crashes improve with energy-absorbing steering column
JL67-10-36 671025

Vehicle understeer and characteristic speed measured by three tests
JL67-11-46 671041

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

STOL Aircraft

Partial-lifting system is optimal control system for large V/STOL transports
JL67-1-54 670412

Stratified Charge Engines

Jeep engine gets stratified charge combustion
JL67-4-63 670759

Structural Analysis

Increased design complexity yields to automated design with aid of digital computer
JL67-10-43 671026

Structures

see:
Aircraft Structures
Spacecraft Structures

Superalloys

Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Supercharging /Superchargers/

see:
Turbocharging /Turbochargers/

Supersonic Transports

Techniques planned to minimize time required on Boeing supersonic transport for unscheduled maintenance
JL67-7-46 670987

Controls that adjust the variable geometry air inlet of the supersonic transport are vital to successful supersonic flight
JL67-10-54 671031

Four possible parking arrangements for the Boeing SST
JL67-11-50 671043

Suspension Systems

1967 European cars show changing trends
JL67-2-36 670415

Large chassis dynamometer tests of tractor-trailer reveal ways to improve tractor-cab ride
JL67-3-60 670433

Rail travel is about to be changed by lightweight, streamlined, high-speed trains designed for passenger comfort
JL67-6-40 670787

Shock, vibration, ride dynamics and suspension are main factors in ground missile-carrier design
JL67-7-56 670993

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Systems Engineering

Systems analysis is used to develop prototype design of New York State Safety Car
JL67-3-36 670429

T

Tantalum Alloys

New protective coatings allow use of columbium and tantalum alloys in reusable reentry vehicles despite their poor oxidation resistance
JL67-10-46 671029

Test Equipment

Occasional overloads cause bolt loosening
JL67-8-64 671006

Test rig measures heat transfer of various piston cooling methods
JL67-9-47 671015

New apparatus measures friction characteristics of controlled-slip differential lubricants
JL67-9-66 671020

Test Facilities

Quasi-steady-state data from wind tunnel tests are adequate for analysis of car stability in wind gust conditions up to 15-deg yaw angles
JL67-6-66 670793

Testing

see also:
Field Tests
Impact Tests
Test Facilities
Wind Tunnel Testing

Six guidelines to help engineers design highway truck tractor frames
JL67-2-50 670417

Two approaches to control of turn signal flasher quality
JL67-3-66 670435

Manual testing is still needed in many space programs
JL67-3-100 670446

Vehicle understeer and characteristic speed measured by three tests
JL67-11-46 671041

Concentration shifts of the total or a particular exhaust emission may not reflect, even in direction, concentration shifts of other emission constituents
JL67-11-58 671045

Dynamic versus static spring rates for vibration mounts. Dynamic spring rate dependent on four variables. Two dynamic test methods described
JL67-11-80 671050

Bending moment on Atlas booster tank is increased 50% after wrinkling first occurs in this large thin-walled cylinder
JL67-12-60 671052

Thermostats

Vapor pressure comparator will operate satisfactorily under abnormal conditions
JL67-5-80 670785

Thrust Vector Control

Automatic stability augmentation system integral with Boeing H-46 flight control system ensures good stability without an autopilot
JL67-10-64 671034

Tires

Large chassis dynamometer tests of tractor-trailer reveal ways to improve tractor-cab ride
JL67-3-60 670433

Change to narrow-row spacing will have modest impact on tractor design and usage
JL67-5-45 670771

Reliable tire monitoring systems are too costly; low-cost systems are unreliable. All systems lack flexibility for trailer interchange
JL67-5-66 670780

Unified theory of rubber friction reveals role of adhesion component in tire-road surface coupling
JL67-8-70 671008

Both laboratory and on-the-road tests compare 2- and 4-ply tire performance. 2-ply is found superior in almost all tests
JL67-10-79 671037

Titanium Alloys

Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Titanium is being readied for major role in SST design
JL67-6-78 670795

Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Tractor Scrapers

Ride simulator speeds design studies aimed at operator comfort
JL67-5-54 670776

Traffic Safety

Ford and Bureau of Public Roads are developing systems to improve vehicular communications on the highway
JL67-12-73 671054

Trailers

see:
Truck Trailers

Transmissions

see also:
Automatic Transmissions
Manual Transmissions

World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Transport Aircraft

see:
Supersonic Transports

Truck Design

Six guidelines to help engineers design highway truck tractor frames
JL67-2-50 670417

World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Truck Trailers

Large chassis dynamometer tests of tractor-trailer reveal ways to improve tractor-cab ride
JL67-3-60 670433

Turbine Blades

Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Business jet service life is being lengthened with a combination of film and convection cooling for turbine stator and rotor blades
JL67-12-78 671056

Turbine Engines

see also:
Turbofan Engines
Turbojet Engines
Turboshaft Engines

Gas turbines promise profits for off-highway vehicle users
JL67-2-70 670421

Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Gap between achieved life and design life of gas turbine components can be narrowed. Practical approach can bring large cost savings
JL67-2-94 670428

Protective coatings help to extend jet engine part life
JL67-3-78 670438

Goal of in-service development is more and faster repair to extend jet-engine component life and reduce maintenance cost
JL67-6-62 670791

Ammonia and hydrocarbons theoretically compared as turbine fuels on basis of power output, thermal efficiency, and fuel economy
JL67-6-71 670794

Corrosion and radiation effects must be minimized in fuels for automotive turbine engines
JL67-7-69 670996

Otto- and diesel-cycle-engines will remain dominant mobile powerplants in next 10–25 years; later, fuel cell and battery will emerge
JL67-8-60 671005

Turbocharging /Turbochargers/

Turbochargers will get smaller, more reliable, and more efficient
JL67-2-68 670419

400-bhp engines will be common on trucks in five years, and matching transmissions to them may be more difficult than before
JL67-8-43 671000

Turbofan Engines

A seating capacity of 500 will be needed to produce a 20% drop in direct operating costs, compared with today's large jets
JL67-3-70 670436

Turbojet Engines

Jet engine in high-speed stall can stall other engines in cluster
JL67-3-48 670430

Turboshaft Engines

Rail travel is about to be changed by lightweight, streamlined, high-speed trains designed for passenger comfort
JL67-6-40 670787

Two Stroke Cycle Engines

Effect of cylinder and exhaust system modifications on the performance of 2-stroke-cycle engines
JL67-4-43 670753

Reducing the oil concentration in fuel for 2-stroke-cycle engines has marked advantages, but careful formulation of the oil is necessary
JL67-6-59 670790

Techniques for indirect measurement of scavenging parameters show promise for evaluating scavenging efficiency
JL67-11-72 671048

V

Value Engineering

Value engineering pays off. Two-word problem definitions and placing monetary values on performance are essentials
JL67-2-84 670425

Valves /Valve Mechanisms/

Fuel factors producing corrosion can be identified and corrosion life of valve alloys measured by drilled-hole engine-mounted test
JL67-1-43 670408

New remote controlled valve simplified vehicle hydraulic systems
JL67-3-63 670434

Chevrolet's V-8 "Turbo-Jet" passenger car engine was designed primarily to increase volumetric efficiency
JL67-8-66 671007

Demand valve switches flow from steering to implement circuits in articulated vehicle
JL67-9-42 671014

Brake response in passenger cars and trucks improves when brake proportioning valves adjust brakes for dynamic and static loading
JL67-9-58 671019

Variable Compression Ratio Engines

Nitrogen oxides found in spark-ignition engine exhaust are flame-formed
JL67-7-52 670991

Vehicle Design

Vehicle understeer and characteristic speed measured by three tests
JL67-11-46 671041

Vehicle Directional Control

Quasi-steady-state data from wind tunnel tests are adequate for analysis of car stability in wind gust conditions up to 15-deg yaw angles
JL67-6-66 670793

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JL67-9-58 671019

Vehicle understeer and characteristic speed measured by three tests
JL67-11-46 671041

Vehicle Safety

Systems analysis is used to develop prototype design of New York State Safety Car
JL67-3-36 670429

Restraint systems promise substantial crash protection
JL67-4-58 670758

Shielding is important part of farm machinery safety but other factors are vital, too
JL67-4-88 670768

Restraints used in Los Angeles police cars include seat belt and double shoulder straps–plus crash helmets
JL67-8-86 671010

Driver's chances of survival in head-on crashes improve with energy-absorbing steering column
JL67-10-36 671025

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Criteria given for safe windshield. Of paramount importance is the type of glass and mount: windshield should be made of laminated safety glass, loosely mounted
JL67-12-76 671055

Ventilation

Car body aerodynamics play an important role in heater airflow
JL67-9-50 671017

Vibration

see also:
Aircraft Vibration

Ride simulator speeds design studies aimed at operator comfort
JL67-5-54 670776

Shock, vibration, ride dynamics and suspension are main factors in ground missile-carrier design
JL67-7-56 670993

Occasional overloads cause bolt loosening
JL67-8-64 671006

Increased design complexity yields to automated design with aid of digital computer
JL67-10-43 671026

Dynamic versus static spring rates for vibration mounts. Dynamic spring rate dependent on four variables. Two dynamic test methods described
JL67-11-80 671050

Vision

Systems analysis is used to develop prototype design of New York State Safety Car
JL67-3-36 670429

VTOL Aircraft

see also:
Helicopters

Partial-lifting system is optimal control system for large V/STOL transports
JL67-1-54 670412

W

Wankel Rotating Combustion Engine
Otto- and diesel-cycle-engines will remain dominant mobile powerplants in next 10–25 years; later, fuel cell and battery will emerge
JL67-8-60 671005

Warning Systems
Two approaches to control of turn signal flasher quality
JL67-3-66 670435

Reliable tire monitoring systems are too costly; low-cost systems are unreliable. All systems lack flexibility for trailer interchange
JL67-5-66 670780

Different intensity day and night turn signals, improved headlight low beam for turnpike driving stir attention in Europe
JL67-11-36 671039

Welding
Through partition cell connector increases battery starting power
JL67-4-68 670760

Titanium is being readied for major role in SST design
JL67-6-78 670795

Wind Tunnel Testing
Quasi-steady-state data from wind tunnel tests are adequate for analysis of car stability in wind gust conditions up to 15-deg yaw angles
JL67-6-66 670793

Windshield Wipers
D-c variable-speed motor has superior performance, decreased size and cost. Initial use is as windshield wiper motor
JL67-5-76 670783

Windshields
Computers speed body engineering
JL67-6-56 670789

Criteria given for safe windshield. Of paramount importance is the type of glass and mount: windshield should be made of laminated safety glass, loosely mounted
JL67-12-76 671055

Wings /Aircraft/
Pilots not qualified to fly with instruments perform well in light aircraft if they use a wings-leveling device in instrument weather
JL67-5-82 670786

X

X-Ray Inspection
Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

ABSTRACTS OF TECHNICAL ARTICLES

SAE JOURNAL—JANUARY THROUGH DECEMBER, 1967—VOL. 75

670206 (JL67-6-84) **Titan III Family . . . Versatile Space Performers.** Wayne B. Leslie and Glen J. Dickman, Martin Co. The Air Force's Titan III program is turning out one of the most versatile space launch systems that has yet been devised. By using a building block technique in which the components are added on or taken off, a family of boosters is being developed which will be able to economically meet mission payload requirements well in excess of any current booster system except that of the Saturn V. The family of boosters is currently comprised of three vehicles, the Titan IIIA, the Titan III R.G. (radio guided) Core, and the Titan IIIC.

670407 (JL67-1-36) **Titanium Alloys Look Best for Mach 3 Transport Aircraft.** P. H. Denke, C. W. Bentley, and R. T. Hunt, Douglas Aircraft Co., Inc. To protect Mach 3 transport aircraft from failure due to the formation of structural cracks:

- Materials of maximum fracture toughness must be used.
- Means of arresting crack growth are also required, since, with the repeated stressing expected at high temperatures (wing leading edges may exceed 600 F, and large areas of the plane may be subjected to 500 F for long periods), cracks may develop due to imperfections in even the best fabricated material. But it is essential that the cracks do not grow, causing catastrophic failure.

Investigations show that:

- Fracture toughness at both room and elevated temperatures was best for titanium alloys Ti-8Al-1Mo-1V and Ti-6Al-4V, with René 41 CRT running a close second. PH 15-7Mo RH1100 proved to be the least suitable material of the five alloys tested.
- Fatigue life of specimens was improved by (1) increasing the thickness of the crack arresters, and (2) the addition of skin splices at the crack arresters. Composition of the skin material had a moderate effect on fatigue life, whereas the composition of the crack arresting material had almost no effect, and it did not matter whether the crack arresters were spotwelded or riveted to the panels. The addition of frames at each crack stopper also increased the fatigue life of the alloys tested.

670408 (JL67-1-43) **Laboratory Test Measures Corrosion Life of Diesel Valves.** Vernon A. Johnson and Clifford W. Galen, Eaton Mfg. Co. An accelerated drilled-hole engine-mounted laboratory test allows the corrosion life of diesel valves to be studied independently of other causes of valve failure. It has been successfully used to determine:

- The corrosion life of identical valves with various fuels, and therefore the fuel characteristics which produce corrosion.
- The corrosion life of different valve alloy materials with the same fuel.

670409 (JL67-1-47) **The Little Things Are Killing Us on Construction and Earthmoving Equipment Used in Viet Nam.** Col. Frank Milner, Army Engr. Res. and Dev. Labs. Generally we've been getting good construction and earthmoving equipment in Viet Nam. But it is the little things that are killing us in this war in a far-off country.

One piece of equipment, for example, was replete with hydraulic systems and said to be designed specifically for working in rugged terrain. The exposure and routing of the hydraulic line was ill-adapted to the equipment's required use. At least half a dozen lines were so positioned that chafing and interference would endanger hydraulic operations. A cursory inspection revealed work needed on at least a dozen lines to prevent their being torn off, cut, or otherwise damaged in rough terrain operations. In 30 miles of operation, one hydraulic line actually did chafe halfway through.

670410 (JL67-1-48) **Electronic Feedback Control Gives Continuous Engine Tune-Up for Best Power and Fuel Economy.** P. H. Schweitzer, Optimizer Control Corp.; Carl Volz, Pennsylvania State Univ.; and Frank DeLuca, American Bosch Div., American Bosch Arma Corp. An electronic feedback control has been developed for continuously correcting the setting (for instance, spark timing) of a power-producing machine for best power (which usually also means best fuel economy).

Since almost every engine has a rotating shaft whose maximum power output depends on the correct setting of an adjustment, the new device, called an "optimizer," has numerous potential applications.

670411 (JL67-1-53) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Supervisors often provide information and estimates that enter into budget preparation. They also use budget figures as a guide during the year. The budget has several uses within the organization, but from the standpoint of a supervisor, it is there to serve him.

670412 (JL67-1-54) **Partial-Lifting Systems Provide Optimal Control for Large V/STOL Transports.** Thomas E. Lollar, Frank J. Bus, and David M. Dolliver, Airplane Div., Boeing Co. The optimal control system for a large V/STOL transport is a "partial-lifting" system—one which assists in lifting, except under full-control conditions. This conclusion was reached in a study to find the control system which would give adequate control under severe gust conditions with minimum gross weight. The study was in three phases:

- Control requirements.
- Possible control systems.
- Optimal control system.

670413 (JL67-1-60) **An 8-Step Method for Successful Decisionmaking.** A. R. Kluckner, British Columbia Hydro and Power Authority. Specifying and stating a problem is the tough, but very important first step toward successful decisionmaking. To solve a problem a manager must be sure he knows what should be happening. For this, he requires information and background about:

- His objectives, targets, goals.
- What policies and procedures to apply, and which may restrict him.
- What decisions of his and others will exert a controlling influence.
- What end result is expected.

He has to get to the root causes. True, he may have to take immediate interim action, or the roof falls in. But this doesn't relieve him of the necessity eventually to get to the basic cause of the problem.

670414 (JL67-1-62) **Cool Approach to Engine Reliability.** Charles L. Moon, White Motor Corp. Today's truck designer, striving for maximum overall reliability, must give careful consideration to the engine cooling system. Filling and deaeration capabilities, and total coolant capacity must be adequate to serve the needs of the engine. Reserve capacity against leakage and overflow must be provided. The system design must minimize cavitation and corrosion problems. Component construction must, of course, be durable, efficient, and economical of power.

670415 (JL67-2-36) **1967 European Cars Show Changing Trends.** Maurice Platt, engineering consultant; and Joseph Lowry, technical writer. Swing to front drive has halted and individual appearance of European cars has given way to international styling. But new fuel-injection systems, new suspensions, and a new transmission are among the developments announced in the past year.

670416 (JL67-2-48) **CSD Generating Systems Keep Pace with Aircraft.** Frank R. Cordon and David J. Hucker, Sundstrand Aviation. Two developments that are helping to make the constant-speed-drive generating systems used on the latest jet aircraft lighter, more reliable, and capable of longer life are:

- Axial gear differential constant-speed drive.
- Oil-cooled and lubricated brushless rotating rectifier generator.

670417 (JL67-2-50) **Six Guidelines To Help Engineers Design Highway Truck Tractor Frames.** William J. Sidelko, Ford Motor Co. Highway truck tractor frames can be designed in a systematic, objective way, so as to be durable and reliable, as well as economical to build and operate. The method—illustrated by specimen calculations and data from the design process of one such truck frame—consists of six steps. These are:

- Establishment of the overall frame dimensions.
- Preliminary design of sidemembers from simple beam theory.
- Establishing realistic road loads by field measurements on a similar truck.
- Refining the preliminary design in the light of load data.
- Laboratory tests of prototype frames, applying simulated operational loads.
- Field tests of prototype vehicles.

670418 (JL67-2-64) **Fan-Heater Circulates and Heats Cryogenic Oxygen for Space Duty.** S. R. Phillips, Cosmodyne Corp. A fan-heater has been designed to circulate and heat cryogenic oxygen to maintain it as supercritical fluid at 2400 psig and −170 F in a space vehicle storage tank. (Critical temperature of oxygen is −181 F; critical pressure is 731 psia.) Without the fan-heater, the supercritical oxygen might separate into liquid and gas, due to decreased pressure, as it is withdrawn during the mission for the auxiliary power system and pilot breathing.

The unit uses a wet-winding motor with ball bearings, and a three-element electric heater. All parts are fully exposed to oxygen and are made of oxygen-compatible materials.

670419 (JL67-2-68) **Turbochargers Will Get Smaller, More Reliable and More Efficient.** Glen Holzhausen, AiResearch Indust. Div., Garrett Corp. More air for fewer dollars is the promise of future turbochargers, with improvements in compressor, turbine, and mechanical efficiencies.

Existing turbochargers are suitable for engines down to 150 cu in. displacement; in the next few years they will be made applicable to engines down to 100 cu in. Such a unit will weigh about 9 lb and fit within a 5½-in. cube. It would have an impeller diameter of 1.9 in. and operate up to 175,000 rpm. Governing factors will be ability to make conponents in this size with sufficient efficiency to perform adequately and at a cost to make it economically feasible for the engine builder.

Also on the horizon is a 5/1 pressure ratio turbocharger system with sufficient range for engine lugging. Its advent will depend on the rate of development of engines capable of accepting these high pressures. Current turbochargers have pressure ratio capabilities well beyond those of most industrial diesel engines.

670420 (JL67-2-69) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Efficient utilization of manpower benefits employees, supervisors, and the organization. Its implementation takes managerial rather than technical ability. Even though their primary interest may be technical problems, supervisors should pay particular attention to this responsibility.

670421 (JL67-2-70) **Gas Turbines Promise Profits for Off-Highway Vehicle Users.** Glen W. Kahle, Engrg. Res. Div., Deere & Co. The gas turbine can compete with the diesel for installation in off-highway vehicles of 600 hp or less because:

- Fuel economy of the turbine has improved to where it is close to that of the diesel.
- With the proper engine and transmission combination, even the single-shaft turbine can duplicate current diesel vehicle performance.

Gas turbine engines will produce profits for both vehicle manufacturer and vehicle user . . . even though their initial cost is much higher than that of the diesel.

The current development status of the gas turbine—equal to that of the diesel less than three decades ago—is discussed below in terms of thermodynamics, aerodynamic efficiency, and specific power. In addition, some of the many technological advances that will characterize future vehicular turbines—and make them more attractive—are listed.

670422 (JL67-2-77) **Data Processing Aids 5-and-50 Warranty Success.** G. H. Redmond and F. M. Webster, Chrysler Corp. The Warranty Edit and Inquiry System used by the Chrysler Corp. to implement their 5 years or 50,000 miles Warranty Program for cars makes use of an RCA 3301 computer, RCA 3488 Random Access Computer Equipment (RACE) files, and a cathode ray tube display unit.

670423 (JL67-2-80) **Self-Motivation Key Element in Continuing Education Success.** Irving I. Raines and John F. Connors, Martin Co. Self-motivation is an essential ingredient in continuing education. All learning is essentially self-learning. And self-learning requires self-discipline—which, in turn, requires strong motivation to sustain itself.

The Joint Advisory Committee on Continuing Engineering Studies emphasizes these fundamentals when it concludes:

"Advances in the development of continuing engineering study programs will be made at a significantly faster rate if due consideration is given to motivational factors of engineers and how to use these effectively to foster positive reactions to any given program."

Industry has much to learn about this essential ingredient of continuing engineering study . . . about this self-induced stimulus that causes a person to act.

670424 (JL67-2-82) **Two Parameters Define**

Effects of Deposits on Engine Performance. J. P. Bradish, Mechanical Engrg. Dept., Marquette Univ.; P. S. Myers and O. A. Uyehara, Mechanical Engrg. Dept., University of Wisconsin. The effects of deposits on engine performance, as measured by several engine performance parameters, can be expressed in terms of:

- Thermal resistance, x_d/k_d, where x_d is the deposit thickness and k_d is the deposit thermal conductivity.
- Thermal penetration, $\sqrt{(\rho kc)_d}$, where k is the deposit thermal conductivity, ρ is the deposit density, and c is the deposit heat capacity.

These were some of the results of the University of Wisconsin tests.

670425 (JL67-2-84) **Value Engineering Pays Off.** Jerry W. Moon, LTV Michigan Div., Ling-Temco-Vought Aerospace Corp. The value engineering portion of a recent technical society symposium on applied creativity presented the best route to increased profits from organized creative effort. More important, it showed how these benefits can be realized through the efforts of noncreative "typical" employees—"you, me, and our associates." Probably the most important reason for the effectiveness of value engineering is that it provides techniques to stimulate, focus, and also act upon the brilliant flashes of originality produced by uninhibited creative thinking.

How to get started is always a major problem with any new program. If a design or product exists, a sure-fire method for listing study areas is simply to record the assemblies and/or parts which make up the bulk of the cost. It also pays to keep in tune with those who have previously worked on the particular item. If given the opportunity a design engineer, for example, will almost always mention that, if he had had more time or the requirements had been different, he could have come up with a less-costly design. His ideas and those of others give a good "starter" list—one that grows much faster than the projects can be completed.

670426 (JL67-2-86) **Plexiglas H Is Acrylic-Based Plastic for Higher Temperature Service in Automotive Signal Lenses.** R. C. Oglesby and O. L. Pierson, Plastics Dept., Rohm & Haas Co. A new acrylic-based plastic—Plexiglas H—has been developed to withstand the higher temperatures reached by some of today's brighter automobile signal lamps. The new material attains the required heat resistance while retaining such inherent advantages of acrylics as: weather resistance, dimensional stability, breakage resistance, high clarity, and precise moldability. Chemical resistance is about the same as that of the older acrylics, but there are some changes in optical properties that must be considered in the design of Plexiglas H parts. Larger thermal expansion, due to the greater temperature range of operation, must also be considered.

Molding does not present any special problems, requiring only higher temperatures on standard injection machines.

Signal colors meeting SAE specifications have already been developed, and approved by the State of California, and others can be produced as the need arises.

The improved heat resistance means that the new material will also be able to replace glass in certain applications, where heat is generated.

670427 (JL67-2-90) **Miniature Airfoils Test Thermal Fatigue of Aircraft Gas Turbine Alloys.** Matthew J. Donachie, Jr., Robert P. Brody, and Elihu F. Bradley, Pratt & Whitney Aircraft Div., United Aircraft Corp. Miniature airfoil tests of turbine blade and vane alloys give reliable thermal fatigue and bow (bending) data because they reproduce actual corrosive and erosive environments. . . . And these tests can predict relative performance of alloys faster than other tests.

A series of airfoil tests was made to compare thermal fatigue and bow resistance of a new nickel-base alloy, PWA 663 (B-1900), with the performance of other vane and blade alloys. Strain cycling and creep tests were also made, and the results compared. Coated PWA 663 alloy had the best bow and crack resistance.

670428 (JL67-2-94) **20 Ways To Lengthen Life of Gas Turbine Parts.** J. J. Eden, Air Canada. The current 58% life extraction efficiency of gas turbine components could be raised to 75%, with a resultant saving of about $3 per engine hr, or 10% of direct aircraft maintenance cost, if more effort were concentrated on developing ways of extending component life. 20 practical suggestions for making parts last longer are given.

670429 (JL67-3-36) **New York State Safety Car Makes Its Debut.** The New York State prototype vehicle is designed to sustain front end impacts at 50 mph, 40-mph side impacts, rear impacts at 50 mph, and rolling impacts at 70 mph with a reduction of at least 50% of the grades of injury from moderate through fatal.

It is estimated that with the design conditions for front end and side impacts, 75% of fatal accidents in rural and city driving will be covered, while for roll-over and rear end impacts the coverage will be 90%.

Two basic design concepts have been developed—Concept I for a family of cars with high safety level; Concept II with a reduced safety level, accounted for by less provision for front end energy absorption, less space for passenger displacement under crash loads, and a primary structure of lower rigidity. Both designs have proportions typical of today's full-size cars.

The study leading to prototype design of these vehicles covered all phases of vehicle safety—collision prevention, prevention of injury to occupants in crashes, prevention of injury to pedestrians, post-crash environment, and nonoperating safety.

670430 (JL67-3-48) **Engine in High-Speed Stall Can Stall Other Engines in Cluster.** J. S. Alford and I. W. Victor, Large Jet Engine Dept., General Elec. Co. Gases hot enough to stall adjacent engines are expelled forward for a considerable distance following high-speed stall of a jet engine. This was demonstrated by dynamic pressure and temperature measurements taken in a length of pipe mounted in front of a full-scale engine that was intentionally stalled. In a cluster engine installation, these adverse inlet flow conditions would require adequate isolating lengths of inlet duct, adequate stall margin, or an adjustment to the operational procedure to prevent a series of alternating stalls.

670431 (JL67-3-54) **Forming Metal Parts by Expansion.** Ralph E. Roper, Wallace Expanding Machines, Inc. Material savings of 15–50% of original blank area, and an improvement in quality have been achieved in the production of a variety of product shapes by stretch-forming a sleeve of sheet metal, preformed into a cylindrical or rectangular welded section. The section to be formed is expanded, increasing the girth dimension as the shaping is generated.

The Wallace expanding process is capable of both one-piece and multiple-piece expansions. Examples of one-piece expansions are automotive fan shrouds, motor casings, and many nonautomotive products. Multiple expansions include doors, hoods, deck lids, fenders, quarter panels, toe and dash panels, gas tank halves, and roof panels.

670432 (JL67-3-56) **Flight Operations from a Circular Runway Are Feasible.** Com. Lloyd H. Smith, Aircraft Projects Dept., Naval Weapons Evaluation Facility. Flight operations from a circular runway are feasible, tests conducted by the Bureau of Naval Weapons show. These tests were made with a portion of a circular track at the General Motors Desert Proving Ground; test aircraft included a T28, A1-E, A4-B, and C54. The most outstanding test result was that the aircraft had unusually strong directional stability during ground roll on a circular runway . . . much better than that on a flat runway.

670433 (JL67-3-60) **Large Chassis Dynamometer Tests of Tractor-Trailer Reveal Ways To Improve Tractor-Cab Ride.** J. C. Vaverek, Fruehauf Corp. Fruehauf is using a 400-hp (electrical) chassis dynamometer to provide the environment for demonstrating tractor-trailer ride dynamics. With the data derived from this test facility it has been possible to reduce the pitch amplitude and shift its frequency to a less used portion of the vehicle speed spectrum.

670434 (JL67-3-63) **New Remotely Controlled Valve Offers New Scope in Hydraulic Systems for Off-Road Vehicles.** Robert E. Kay, Vickers Inc. An electrically controlled directional valve, of new design, promises to allow a new freedom in hydraulic circuit design for vehicles. The valve was developed to possess the same metering characteristics as its manually operated counterparts. The valve is designed to achieve this new freedom by using a closed-center system rather than the generally accepted open-center type of system. The simplification that's possible in the hydraulic circuit of a utility truck provides an ideal example of this new concept.

670435 (JL67-3-66) **Two Approaches to Control of Turn Signal Flasher Quality.** G. R.

Smith, D. R. Dunlop, and D. M. Finch, Institute of Transportation & Traffic Engrg., University of California; Thomas K. Brichford and James W. Murray, Metal Stamping Div., Ford Motor Co. Newly developed flasher testing equipment at the University of California Motor Vehicle Devices Testing Facility has increased durability testing circuits from 40 to 120. Performance evaluation equipment also has been improved and its capacity increased from 1 to 10 flashers at a time. Further, sample handling time during test has been reduced. Compactness was stressed in the new equipment to conserve space.

In accordance with specified requirements for approval, flashers are subjected to tests of two basic types:

1. A durability test of two 100-hr periods of cyclic operation.
2. A test of performance characteristics at room temperature and at specified high and low temperatures.

670436 (JL67-3-70) **To Lower Operating Costs 500-Passenger Planes Will Be Needed by 1972.** F. Searls and C. Y. Joe, United Air Lines, Inc. The advanced jet engines expected to be available about 1972 should provide the airlines with a 20% improvement in direct operating costs, compared with today's big jet transports. But to gain these lower costs, the planes must have seating capacities far greater than today's planes—of the order of 500 passengers. (Thus, any thought of reengining the jets already in operation—such as the DC-8-61, which carries 250 passengers—is out of the question. This would only increase operating costs.)

Manufacturers are centering their development efforts on light, short, relatively high temperature, high bypass ratio engines for the next generation of large jet transports. The object is to obtain the best airframe-engine combination for maximum flying efficiency at Mach 0.9 in the 30,000–40,000-ft altitude range.

670437 (JL67-3-72) **Battery Life Span Continues To Increase.** A. Sabatino, Gould-National Batteries, Inc.; Thomas J. Varga, General Parts Div., Ford Motor Co.; J. P. Badger, Prestolite Co.; and E. O. A. Blaich, Robert Bosch GmbH. Modern batteries are lasting longer than those of a few years ago, thanks to improvements in:

- Battery construction.
- Electrical systems.
- Battery environment.

Performance of dry-charge batteries is being improved through a better understanding of the effect of processing conditions.

The current use of plastics for the battery containers is helping to make batteries smaller and lighter.

670438 (JL67-3-78) **Protective Coatings Help To Extend Jet Engine Part Life.** W. E. Helfrich, Pratt & Whitney Aircraft Div., United Aircraft Corp. Wear of nonlubricated jet engine parts caused by vibration, fretting, sliding impact, or a combination of these can be improved significantly by the use of plasma sprayed or detonation flame plated coatings.

Both methods of coating are being used to apply the coatings to production parts of jet engines in manufacture as well as to repair worn parts in the commercial airline shops.

670439 (JL67-3-81) **Laboratory Antirust Oil Test Results Checked in 4000 Miles of Field Testing.** E. A. Isringhaus, Jr. and B. M. Henderson, Wood River Res. Labs., Shell Oil Co. The 1965 version of the MS Sequence IIa-IIIa seems to offer the most promise as a means of predicting the service antirust performance of engine lubricants. This is one of the conclusions drawn from three series of tests involving more than 4000 miles of "Aunt Minnie" operation (a mythical prototype for the small percentage of owners who use their cars for a few short trips daily, these trips being separated by several hours of outdoor parking. This kind of operation provides the most severe type of rusting test.)

The field tests involved a total of 40 cars, and were conducted at Wood River, Illinois, and at Winnipeg, Manitoba, Canada. The tests, which were closely controlled, lasted from three to six months. The test vehicles were 1964 and 1965 models of a particular make of passenger car, equipped with 170 cu in. displacement 6-cyl engines and automatic transmissions.

670440 (JL67-3-85) **Various Component Gases of Engine Generated Pollution Pose Differing Health Hazards.** Ernest S. Starkman, College of Engrg., University of California. Unburned hydrocarbons, oxides of nitrogen, carbon monoxide, and carcinogens are among the emissions generated by engines. Each produces hazards of varying importance and each presents a differing control problem.

670441 (JL67-3-88) **Vips Need Economic Justification for Capital Equipment Buys.** Richard W. Johnson, Aro Corp.; Michael J. Dellape, Baltimore Div., Martin Co.; and Edvin Auzenbergs, TRW, Inc. Capital expenditures for equipment today result from decisions based on data developed by well-programmed processes. Top management makes final decisions on the more important of such expenditures. But effectively implemented presentations of the economic justification of capital equipment proposals are required to permit those final decisions to be sound.

Manufacturing managers, experienced in developing such proposals, agree generally on five requirements for a good, dynamic equipment policy procedure:

1. *Established product plan:* Someone, during the planning period, must establish amount that can be spent on capital projects in the coming year, and someone must set forth the product line objectives.
2. *Proposals:* A means must be provided by which people can propose products for consideration for the budget.
3. *Evaluations and approvals:* Each proposal must be evaluated on merit. A method for gaining approvals must be set down. If qualified demands for funds exceed money available, a method for merit ranking is needed.
4. *Schedule and cost control:* A procedure should be set up for establishing dates for the occurrence of each event; also for periodic reporting of project progress. Also, there should be an established method for disposition of funds when the amount authorized is not spent, and for what-to-do if the authorized amount is overspent.
5. *Followup:* A report telling how successful project was in achieving the results for which it was justified.

670442 (JL67-3-91) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Many organizations and supervisors see the evaluation of employees' performance and qualifications as a problem area, especially as applied to technical employees. Agreement that it takes judgment to evaluate people does not spell out how to get reliable and valid judgments.

670443 (JL67-3-92) **Secondary Surveillance Radar Proves a Boon To Controlling Helicopter Traffic Near Airports.** George Litchford, aviation systems consultant; and John E. Gallagher, New York Airways, Inc. Secondary surveillance radar (SSR) is proving an important part of air traffic control for helicopters during instrument flying weather. It provides accurate information on aircraft identity, position, and height, as well as forward estimates relating to the progress of each flight, so that safe separation can be preserved.

670444 (JL67-3-96) **Moisture-Proofing Car Window Lift Motors.** Robert D. Montgomery, Chrysler Corp. The best way to protect car window lift motors from water damage is to seal the register joints between the motor frame and end bells with a gasket, then use a sealer to seal the heads of the case or thru bolts and the lead wire grommet. It is also less expensive than other methods.

Other advantages of this method are:

- Seal cannot easily be damaged in production.
- Motors can be repaired readily.
- Seal is impervious to oil and grease.
- Process can be applied by motor manufacturer to save shipping back and forth to processors.

This waterproofing method was selected after trying hand application of sealer to thru bolts, register joints, and lead wire grommet, as well as use of drain holes in motor. It can be applied to the integral-type of motor-gearbox design.

To eliminate hand application of sealant, design modifications were made to permit installation of the thru bolts on the outside of the motor frame. Moreover, special motor terminals were designed to make them self-sealing. The gasket material used has a medium-sized granulated cork base with synthetic rubber binder. This material is medium hard, resilient, and suitable for use where the compression is not great.

670445 (JL67-3-98) **Fuel Fired Heater Provides Instant Interior Warmth and Warmer Cold Starting.** H. B. Kulose, Sueddeutsche Kuehlerfabrik Julius Fr. Behr. The use of a fuel fired heater in automobiles and other on-road equipment provides:

a. Instant heat to the car interior and defrosting mechanisms, thus eliminating the hazardous warmup period.

b. Heat which may be used prior to starting to warm the engine, oil, and battery, thus easing engine starting during even the coldest weather.

If the fuel fired heater is used as a boiler, it may be integrated with the more normal warm water heater.

670446 (JL67-3-100) **Manual Testing Is Still Needed in Many Space Programs.** R. W. Gray, Space Systems Div., Lockheed Missiles & Space Co. Manual testing is still required in the developmental testing phase of many space programs, despite the obvious worth of automated high-speed testing in many instances.

670752 (JL67-4-38) **What Will Moon Spacecraft Be Like in Ten Years?** James O. Matzenauer, Space and Information Systems Div., North Amer. Aviation, Inc. Systems different from the current Apollo system will be needed in the mid-late 1970's to carry men and supplies to the moon. They must be developed with the ability to (1) carry a maximum crew per mission, and (2) evaluate many different sites.

One of the main decisions for each mission will be between direct and rendezvous flights. The direct mode of landing multiman crew transports has less operational restrictions and less cost than an advanced lunar orbital rendezvous spacecraft. But the rendezvous spacecraft can land twice as many men per launch.

After it is decided which type of manned spacecraft to use, then a complementary unmanned logistic spacecraft should be selected. . . . It should use the same basic landing modules to assure maximum common usage between manned and associated logistic spacecraft.

These new—or second generation—lunar spacecraft may follow an evolutionary program (after the present Apollo is extended as far as possible) which would progress from transports landing three or four men per launch and logistic support craft having 30,000 lb payloads, to 10–12 man crew configurations with supporting 40,000-lb-cargo launches.

670753 (JL67-4-43) **Small Two-Stroke Engines Get Tailored Performance.** Claus Waker, Fichtel & Sachs A. G. Nonuniform European transportation and traffic laws impose a host of performance restrictions, such as maximum output, maximum speed and vehicle weight on small 2-stroke-cycle engines. Nonvehicular applications demand still other performance characteristics. The multitude of different requirements are most economically satisfied by modification of only the cylinder and exhaust system. This way, in the final assembly of the engine one or another type of cylinder can be combined with a standard, pre-assembled, integral engine and gearbox block to produce an engine having particular characteristics. Engine performance is affected in many ways by the various modifications to the cylinder and exhaust system.

670754 (JL67-4-51) **Retarded Spark Timing Advances Air Pollution Control.** John F. Beach, Mechanical Dept., and Wallace Linville, Air Pollution Control District, County of Los Angeles. Retarding the spark (altering the ignition timing) and reducing cylinder quench area proved to be significant reducers of hydrocarbons and CO in gasoline engines. These were the experiences of the Los Angeles Mechanical Department. A third successful method involved using a device triggered by the crankcase ventilation system.

670755 (JL67-4-52) **Manufacturing Problems Call for Engineering Professionals.** David F. Baker, Industrial Engrg. Dept., Ohio State Univ.; Donald A. Spetta, Grumman Aircraft Engrg. Corp.; Mathias P. L. Siebel, Marshall Space Flight Center, NASA; and Col. Frederic F. Swan, Air Force Contract Management Div., Air Force Dept. At the perimeter of current engineering education discussions appears consideration of the manufacturing engineer, defined by some as "an engineer who has the desire and capacity for finding a way to translate the designer's plan into a manufactured product." Recent SAE-sponsored discussions have brought to focus a variety of opinions about what makes a manufacturing engineer a professional; and what's offered and what's needed to fulfill his educational needs.

The functions of the man who carries a manufacturing engineer title can differ as widely from company to company as do those of the man called advertising manager. But most manufacturing engineers (almost by definition) work for a company which produces a manufactured product. Because manufacturing embraces many industries and many manufacturing technologies, however, it can't easily be identified with specific tasks nor readily covered by a single meaningful definition. Usually, at least four functional areas are the manufacturing engineer's responsibility in the automobile and aerospace manufacturing industries:

1. Tool design (jigs, fixtrues, dies, handling equipment), methods, and processes.

2. Manufacturing projects—planning and control.

3. Industrial engineering, including operations and systems improvement, factory planning, and manufacturing standards and manuals.

4. Tool fabrication, including scheduling and shop loading.

670756 (JL67-4-54) **Hydrostatic Power Steering System Opens New Era in Controllability.** Bernard C. Hudgens, Hydraulics Lab., and Raymon L. Goff, Ross Gear Div., TRW, Inc. A new hydrostatic power steering system, designed specifically for earthmoving equipment, possesses numerous advantages including dual steering ratios and continuous power assist. The pure hydraulic circuit is simple requiring, in addition to a steering wheel handpump, and an engine driven support pump, two valves, two orifices, and two check valves.

670757 (JL67-4-56) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Although the handling of salary and promotion decisions varies with the organization, the supervisor should contribute toward these decisions. He should:

- Know the position classification system as related to his group.
- Learn the salary administration policies and procedures for his group.
- Know his employees' positions and salaries.
- Emphasize responsibilities and performance in evaluating salaries.
- Recommend position and salary changes that reflect his considered judgment.
- Try to make the position or salary system work better; not misuse it.

670758 (JL67-4-58) **Restraint Systems Promise Substantial Crash Protection.** Louis C. Lundstrom, General Motors Engrg. Staff. Many full-scale crash tests have been made by the automobile industry and others to find out what happens to a car and its occupants in a collision. Laboratory tests on impact sleds and other test equipment have provided supplementary information. A careful combination of these studies is required to give us an understanding of the full relationship between the first collision (car versus obstacle) and the second collision (car occupant versus vehicle interior).

670759 (JL67-4-63 **Jeep Engine Gets Stratified Charge Combusion.** Julius E. Witzky and John M. Clark, Jr., Department of Auto. Res., Southwest Research Institute. High speed movies help develop stratified charge version of L-141 Jeep engine, with multifuel capability. Cleaner combustion, higher thermal efficiency and greater effective compression ratio combine with quiet operation to make this engine attractive compared to the Otto cycle engine from which it was derived.

670760 (JL67-4-68) **Through Partition Cell Connector Increases Battery Starting Power.** Daniel Orlando and Thomas Oswald, Globe Battery Div., Globe-Union, Inc. Greater starting power is provided by batteries designed with through partition, resistance welded cell connectors. This new design which is automatically fabricated, and thus uniform, has a homogeneous weld between the two connectors and the partition preventing intercell leakage.

670761 (JL67-4-71) **Myths About Engineers Block Individual Progress.** Irving I. Raines and John F. Connors, Martin Co. Established myths about engineers tend to block the individual's professional development in more than a few areas of industry. Yet the presence of these myths is not surprising, because Americans are probably the world's most prolific myth-makers. One of the most persistent myths about engineers concerns "decadeitis." This myth envisions a thoroughly insulated engineer, who lives in an intellectual vacuum after graduation. Another myth is that a good engineer makes a poor manager. It's a myth, too, that all engineers want to become managers. Some managements also accept the myth that all engineers are equally ambitious and equally adaptable to change.

Though technical advances are prime objectives for an engineer, his tempera-

ment, or disposition is no better suited to frequent changes in his personal life and habits than are those of others. Not all human beings are endowed with equal drive and hunger for material success . . . and fortunately there is ample room in the American economy for stable as well as dynamic engineers–neither of which is a myth.

670762 (JL67-4-72) **Alternators Take to the Air.** Harold L. Wise, Commercial Aircraft Div., Cessna Aircraft Co. Replacing the direct-current generator of a light aircraft with a self-rectifying automotive-type alternator can produce as much as a 60% weight saving. Moreover, the alternator will generate significant amounts of current during ground operation, has simpler controls, and is less expensive.

To gain these advantages, the automotive-type alternator had to undergo several modifications, while the electrical system and accessories had to be changed to accept the inherent electrical "noise" developed by the alternator.

670763 (JL67-4-75) **Cathodic and Anodic Actions Affect CASS Test Response of Anodized Aluminum.** C. E. Michelson, D. C. Montgomery and P. D. Stransky, Olin Mathieson Chemical Corp. A study of anodized aluminum exposed to the CASS test produced the following conclusions:

- Much of the deterioration of the anodic coatings is associated with cathodic activity and the consequent generation of high pH solution.
- Surface scratches on metal or oxide, oxide thickness, degree of sealing, contamination, and oxide crazing affect response to the CASS test.
- Poorly anodized panel edges influence the degree of deterioration.
- Aging (especially high humidity) subsequent to finishing improves the response to the CASS test. The detrimental effect of thermal crazing can be almost eliminated by resealing or exposure to high humidity.

Using this test data, a simplified corrosion mechanism is proposed.

670764 (JL67-4-78) **Elastic Deflection Method Sets End Play in Tapered Bearing Assemblies.** Robert F. Cornish, Timken Roller Bearing Co. A modification of a common technique—namely, the preloading of bearings by housing elastic deflection—provides a ready solution to the frequently thorny problem of setting the end play in tapered bearing assemblies. The new method establishes the shim thickness required for zero end play when it cannot be found by direct measurement or by feel. Then the specified amount of end play may be added to this shim thickness before assembly.

Basically, the no-load shim gap is found by measuring the shim gap and housing cap elastic deflection at various axial loads, and extrapolating to zero load. Once the cap deflection curve is known, the no-load (zero end play) shim thickness can be obtained from one measurement of shim gap under a known load—hence the suitability of this method for production line use.

670765 (JL67-4-80) **Four Factors Affect Aircraft Spark-Plug Operation.** R. L. Anderson, Champion Spark Plug Co. From field operational experience, four important factors emerge as influencing aircraft spark-plug operation. These are:

1. Spark-plug design.
2. Combustion deposit fouling.
3. Spark-plug selection to the engine requirements.
4. Engine and fuel factors.

670766 (JL67-4-84) **New SAE Carbon Steels Provide More Uniform Hardenability Range.** Arthur H. Smith, Cadillac Motor Car Div., GMC. Five new grades have been added to the list of SAE carbon steels to provide a better graduated hardenability range between SAE 1026 and SAE 1027. The new grades are: SAE 1513, SAE 1518, SAE 1522, SAE 1525, and SAE 1526. In addition, the SAE 1500 series is being used to designate all carburizing grades of steel having a possible manganese content of 1% or more. (The new 1500 series steels will also appear in the AISI numbering system.)

670767 (JL67-4-86) **Three Mutually Perpendicular Lines of Sight, in One Setting.** Robert E. Brasier, Boeing Co. The establishment of the normal reference system for jig structures, three mutually perpendicular lines of sight, in one setting has been made possible by a new instrument: the 3-directional square. This advance resulted from a new prism design. Beside the resultant savings in setup time, a simple accuracy check is inherent in the new 3-directional square design.

670768 (JL67-4-88) **Shielding Is Important Part of Farm Machinery Safety but Other Factors Are Vital, Too.** E. W. Tanquary, Farm Equip. Div., International Harvester Co. All too frequently farm safety is summed up merely as an effort to provide adequate guards or shielding. But many improvements incorporated in the basic design of both tractors and implements are of equal or greater importance.

670769 (JL67-5-36) **Unified Communication System Promises Safer Driving.** Eugene A. Hanysz, General Motors Res. Labs. A unified communication system designed to provide safer, more convenient, and more enjoyable driving is being investigated by General Motors. The new system, designated DAIR (Driver Aid, Information, and Routing), relieves the driver of much of the burden of scanning the highway for traffic and road signs. It also gives him a convenient and secure way of obtaining emergency service and information.

To do all these things, DAIR provides four basic functions:

- Audio sign.
- Visual sign minder.
- Route minder.
- Code and voice communication.

Testing of the DAIR system revealed a number of practical considerations of some importance.

670770 (JL67-5-42) **Carburetor Is One Key to Exhaust Emission Problem.** Jay A. Bolt and Michael Boerma, University of Michigan. Fuel/air ratio is the predominant factor determining the quantity of unburned hydrocarbons, carbon monoxide, and oxides of nitrogen in exhaust emissions of gasoline engines. This makes accurate carburetor metering highly important, in view of the air pollution problem.

Changes in inlet air pressure and temperature occur with changes in the weather, with altitude, and because of underhood heating. Float-type carburetors fail to compensate the mixture ratio for these variations, and to provide means for correction would add to the cost and complexity.

670771 (JL67-5-45) **Change to Narrow-Row Spacing Will Have Modest Impact on Tractor Design and Usage.** K. W. Anderson, Deere and Co. The trend toward growing corn and soybeans in row spacings of 30, 20, and even 15 in. to increase the yield per acre is having an impact on tractor design and usage. Tires, rear wheel tread, rear axles, and housings are the items most affected by the shift from 40-in. row spacing.

670772 (JL67-5-46) **Long-Life Oils Prove Superior for Montreal Police Fleet.** Lionel L. Reeves, City of Montreal Municipal Shops; and Traian Cabba, BP (Canada) Ltd. Use of SAE 5W/30 long-life engine oil in place of a conventional 10W/30 oil in Montreal police cars has brought about a drastic reduction in the down time related to crankcase oil and filter changes, an increased fleet availability, and an appreciably higher degree of engine cleanliness.

Evaluation of oils was prompted by the fact that the engine cleanliness did not improve as the oil change interval dropped from 1200 miles to 700 miles (within nine years) to compensate for the lower mileage per car as the fleet grew larger. Moreover, problems had arisen ranging from short camshaft life to rocker arm assembly blockage, and there were intervening difficulties related to filters, pans, pumps, and the like.

670773 (JL67-5-48) **Quality Improved and Manpower Cut in Automatic Differential Assembly.** Robert W. Laile, Pontiac Motor Div., GMC. Substantial quality improvements have been achieved by automatically assembling differential units. The assembly is carried out on four integrated, index type, parallel lines with intermixed manual and automatic operations. As the reliability of new automatic equipment increases, manual operations will be automated.

Automatic assembly improves quality as:

- The differential carrier is located during gaging and assembly, using the same locating devices as during its machining operations.
- Less handling of the component parts, by performing "on the line" operations which previously required removal of the part from the manual assembly line. Such operations are:
  1. Assembly of races to carrier.
  2. Preloading of pinion bearing.
  3. Measurement of the pinion cone distance.
  4. Heating of ring gear bore.
  5. Final differential testing.

Handling is also reduced by using magazines to contain oil seals, pinion bearings and races and case side bearings.

•The pallets are rigidly fixed with the transfer bar and shot pins, to provide the proper alignment and positioning for the automatic operations.

•Automatic operations eliminate human errors.

•Less discrepancy in evaluating tooth contact exists as only one inspector is required at the final station.

670774 (JL67-5-50) **New Oxygen Equipment Ahead for High Flyers.** Arthur E. Miller, Scott Aviation Corp. Improvements are ahead in equipment to supply oxygen to the oronasal masks, with which high flyers must live for some years.

Before long, oxygen cylinders may pass out of the picture. Or, their use may be confined to special applications.

Eight promising new approaches to the oxygen storage and distribution problem involve the use of: liquid oxygen, chemical oxygen, closed-circuit oxygen equipment, a very thin membrane which allows molecules of certain gases to pass through it more readily than molecules of other gases, electrolic degradation of water to produce oxygen, reclamation of carbon dioxide in exhaled breath, the principle of gas chromatography, and ionization of air molecules.

670775 (JL67-5-52) **Two Largest Two-Axle Trucks Have Different Design Approaches.** Murray Aitken, KW-Dart Truck Co.; and Walter D. Cashman, LeTourneau-Westinghouse Co. Despite their similar physical appearance, the LeTourneau-Westinghouse LW120A Haulpak and the KW-Dart D-2771 have distinct design differences. The LW-120A has an electrical transmission, and such unique features as an engine-generator-radiator package and an electromechanical brake pedal. The hydraulic retarder is ahead of the transmission in the D-2771, and the rear axle ratio is readily changed, to maximize its efficiency.

670776 (JL67-5-54) **Ride Simulator Speeds Design Studies Aimed at Operator Comfort.** G. E. Burks, Caterpillar Tractor Co. During studies designed to improve the ride for the tractor operator no convenient comfort index could be found; so, a ride simulator was built to enable field conditions to be recreated in the laboratory. Some design trends are already emerging from the use of this simulator.

A ride simulator is necessary as:

•Man has only a very brief "ride memory" between any two conditions he is attempting to compare.

•No reliable comfort index has yet been evolved.

•It is not known which characteristic of ride motion, acceleration, velocity, jerk, or some other, must be measured.

As only the human rider himself can now interpret a given ride, the ride simulator is the only existing realistic and dependable method of evaluating ride improvements. The machine, by recreating field conditions in the laboratory and by allowing repeated comparisons in close sequence, overcomes the short human memory for ride. The machine may be programmed with tape recordings of the vehicle motions over actual terrain, or by electronic stimulae whose variations may be related to changes in various important machine design parameters.

670777 (JL67-5-58) **Simple, Light Muffler with Low Back Pressure Cuts Noise in Light Aircraft.** George A. Alther, Cessna Aircraft Co. A simple but effective muffler, which is based on the resonator principle, has been developed for light aircraft applications. It is capable of reducing the high sound levels heard in the cabin and the annoying aircraft structural vibrations that occur when the exhaust is not suppressed with a muffler. The new design meets space and weight limitations of these aircraft, and has low back pressure.

670778 (JL67-5-61) **New Navy Monopropellant Simplifies Torpedo Propulsion, Handles Safely.** C. L. Adams, Naval Propellant Plant, Res. and Dev. Dept. The Navy has developed a low-cost liquid monopropellant with acceptable handling properties for use in the next generation of naval underwater weapon propulsion systems. The propellant—called Otto Fuel—can be used for other fluid power applications in addition to torpedo propulsion . . . and could possibly become the standard naval monopropellant.

Its chief advantages in torpedo propulsion are system simplicity, ease of reloading practice rounds, and safety of handling aboard ship. The typical torpedo propulsion system has only two fluid pumping elements—one for sea water, and one for Otto Fuel. And since there is only a single propellant, no mixture control problems exist.

No hot gas temperature control is needed, since the flame temperature of the Otto Fuel was tailored to the specific requirements of a positive displacement piston engine. Cooling water is supplied to control engine block temperature.

670779 (JL67-5-65) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. In a very real sense the engineer, as a supervisor, is a communication link for information to travel up, down, and horizontally. How can he handle this as well as all the other more tangible responsibilities? Some of the essentials are these:

•He must keep employees informed on matters affecting them or their work.

•He is a vital channel up the line.

•He must keep his supervisor posted; not wait for him to ask.

•His responsibility also extends to the employees he supervises.

•He must recognize the limitations and the difficulties of communicating with words.

•Communication occurs in numerous ways.

•Supervisors often must edit, without formal instruction.

•He must seek the happy medium between inadequate and excess communication.

670780 (JL67-5-66) **Tire Inflation Monitoring Units Leave Something To Be Desired.** C. E. Strigle, Goodyear Tire and Rubber Co. No tire inflation monitoring device on the market today is wholly satisfactory, yet need for such devices mounts as payloads, horsepower, and axle loads increase.

The most sophisticated systems have the virtues of reliability and low maintenance cost, but their initial cost is too high. Low-cost systems are not sufficiently reliable and they are expensive to maintain. Moreover, no system provides proper flexibility for trailer interchange or interlining.

Tire inflation monitoring devices fall into two general classifications:

1. Warning systems—sound, electrical, and telemetry.
2. Constant inflation systems.

670781 (JL67-5-68) **A Penetrating Study of Meteoroid Barriers for Spacecraft.** John F. Lundeberg, Boeing Co. We need more and better data on the hypervelocity impact response of spacecraft barriers in order to design realistic protection against meteoroids. At present, the real risk of penetration may still be far different from the intended design risk. This is despite the considerable information on hypervelocity impact mechanics with present knowledge of meteoroid environment, and put to use to design single-sheet, multisheet, and multisheet-plus-filler barriers.

But this available information must be augmented and improved in the following ways:

•Over the long term, laboratory simulation of hypervelocity impact mechanics should get better.

•The long term should bring more knowledge of the meteoroid environment, too.

•For the short term, experiments should be conducted to determine penetration consequences for individual parts of the spacecraft, as well as ways to control damage.

Present barrier design techniques as well as current knowledge of constraints placed on barrier design by the damage-control demands of specific components are described.

670782 (JL67-5-75) **Gaining Better Performance for Smaller Batteries.** P. Reasbeck, Joseph Lucas (Batteries) Ltd. More compact battery design, with construction changes, brings 25% reduction in weight plus higher performance and more reliable service for 20-hr capacity production batteries.

670783 (JL67-5-76) **Variable-Speed, Permanent-Magnet D-c Motor's Initial Application Is as Windshield Wiper Motor.** James A. Purdy, Donald S. Perry, and William Diello, Prestolite Co., Syracuse Div. A new variable speed permanent magnet d-c motor has been developed for use with windshield wipers. This new design employs a third (high speed) brush and a circuit featuring a diode and a variable resistor.

Two major design objectives are fulfilled by the new multispeed wiper motor:

•Getting the largest possible spread between low and high speed at light loads. The target low speed should be 40–45 rpm and the high 70–80 rpm for a typical wet glass load of 100 oz-in.

•Making low speed and high speed stall torques nearly identical, thereby protecting the gearing and linkage while providing adequate power for wiper action.

670784 (JL67-5-78) **Diesels Must Lose Weight for Coast Guard Usage.** Lt.-Com. E. L. Parker and Lt.-Com. R. W. Witter, United States Coast Guard. Reducing the installed weight of marine diesels can:

- Reduce fire hazards—diesel fuel flash point is 130 F.
- Increase endurance—the diesel's lower specific fuel consumption reduces total fuel needs which, beyond a certain range, offsets the greater engine weight.
- Lower operating costs.

Continued Coast Guard cognizance of these advantages has produced the required design breakthrough.

670785 (JL67-5-80) **Vapor Pressure Comparator Will Operate Satisfactorily Under Abnormal Conditions.** David L. Van Ostrom, AC Spark Plug Div., GMC. The vapor pressure comparator is a combination pressure temperature switch. It anticipates boiling in a cooling system under conditions where conventional temperature switches fail. In a normally closed cooling system, the vapor pressure comparator pressure-temperature switch is superior under these conditions:

- Reduced atmospheric pressure at high altitudes.
- Reduced pressure cap blow-off pressure due to faulty installation or mechanical failure.
- Loss of cooling system seal due to puncture or loss of hose connection.

670786 (JL67-5-82) **Pilots Perform Better with Wings-Leveling System.** Normal R. Driscoll, Langley Res. Center, NASA. Pilots not qualified to fly with instruments in light aircraft can nevertheless perform well if they use a wings-leveling device when they are caught in instrument weather. For example, tests made with these pilots showed the following:

- Limited navigation and communications tasks—which are beyond the capability of the pilot while controlling the basic aircraft—can be performed with the help of this system.
- Control wheel force developed by the system as a function of bank angle in a steady turn allows the amount of bank angle to be controlled—and is a definite aid in instrument flight to the pilot inexperienced with insturments.

Prior to these tests, experienced research pilots also evaluated the system. They found its overall performance acceptable.... But a slightly lower rate capability and also slightly higher control forces than they actually desired were present.

670787 (JL67-6-40) **Railroads Take Rolling Stock–Go Jet-Age.** Marilyn J. Shilkoff, *SAE Journal*. Just as jet planes changed air travel, so do new light-weight, streamlined, high-speed trains, designed for passenger comfort, seem to be about to change rail travel. There is more emphasis on the short- and medium-hauls–providing quick and comfortable trips between the highly populated cities. Both aircraft gas turbine- and electrically-powered trains will be used. In some cases, improved roadbeds help to make the high speeds possible. In this article, the United Aircraft free-turbine-powered trainsets, and the Budd rail car powered by two single-shaft turbines which use mechanical torque conversion, are described.

670788 (JL67-6-51) **DC-8 "Stretched" Jets Should Produce Less Noise Annoyance at Airports.** R. E. Black, Douglas Aircraft Co., Inc. The new Super Sixty Series of DC-8's, despite their larger size, should present less of a noise annoyance problem at airports than present turbofan jets do, for two main reasons:

- Their maximum perceived noise level is as low as, and under some conditions lower, than that of present jets.
- Because of their larger capacity, fewer flights will be needed to transport a certain number of passengers, which, in turn, means a fewer number of exposures to the noise.

In some cases, also, the annoyance will actually be reduced because the duration of the noise is shortened.

670789 (JL67-6-56) **Computers Speed Body Engineering.** George Pascoe and William M. Hogue, Ford Motor Co., Metal Stamping Div. Body engineers are employing electronic computers and their ancillary controls to advantage in three related but distinct areas. Reductions in lead time have been achieved using numerically controlled machines in such low volume tasks as template, die, and wood model production. Some 4-bar linkages are being designed, and their tolerance requirements evaluated in a two part program. Windshield wiper patterns and windshield optical distortions, problems reoccurring with each model change, may be evaluated analytically without resorting to the use of conventional physical means.

670790 (JL67-6-59) **Oils for Lean-Mixture Lubrication of 2-Stroke Engines.** D. W. Gow and C. E. Trautman, Gulf Res. and Dev. Co. Use of leaner oil-fuel mixtures in two-stroke-cycle engines reduces smoking, air pollution, engine port deposits, and preignitior., as well as the cost of operation. Lowering the oil content brings, however, an increase in the piston-skirt deposits, spark-plug fouling, wear and rusting, unless the oil that is used at the lower concentration is carefully formulated.

670791 (JL67-6-62) **In-Service Developments Prolong Life of Jet Engine Components.** J. F. Leamon and J. T. Pratt, Trans World Airlines, Inc. The keystone of in-service development to prolong the life of jet-engine components is repair—more repair to extend service life; faster repair to cut down the large quantities of unserviceable parts shelved by every airline to await reclamation.

In-service component repair complements the extended overhaul and major inspection periodicity. In a broad sense there are really three categories:

- Simple repair.
- Modification and repair.
- Modification by replacement.

670792 (JL67-6-64) **Explorer IV Demonstrates New Automotive Uses for Acrylics.** R. C. Oglesby, Rohm and Haas Co. With Explorer IV, Rohm and Haas introduces a new acrylic modified Paraplex P polyester resin. This new resin permits production of fiberglass reinforced plastic car bodies with a finish as smooth as carbon steel. The new resin offers low shrinkage, improved surface profile, and excellent paint adhesion, eliminating the sanding and polishing operations formerly required with FRP parts.

Reinforced fiberglass parts made with this resin can be assembled and finished on an auto production line the same way as steel. Neither appearance or physical properties suffer. Manufacturers may thus combine steel and polyester reinforced fiberglass parts in the same car and run it through existing production lines.

The elimination of finishing cuts cost. Theoretically, FRP parts, formerly as economical as steel in annual volumes to 34,000 units, can now compete with steel in annual volumes of 70,000 units. Reduced tooling costs have long been an advantage. The car part for which tooling might cost one million dollars in steel costs less than $250,000 with polyester reinforced fiberglass.

670793 (JL67-6-66) **Wind Tunnel Can Measure Actual Forces and Yaw on Car in Gust.** H. Buning, University of Michigan; and F. N. Beauvais, Ford Motor Co. Forces and moments measured in wind tunnel tests under quasi-steady-state conditions can be used to analyze car stability and handling in wind gusts for yaw angles up to 15 deg. However, overshoot of steady-state values occurs for angles over 15 deg.

These test results were obtained by new research techniques, using the University of Michigan's low-turbulence wind tunnel. A 1/10-scale model was catapulted through the test section perpendicular to the tunnel airflow to simulate a gust condition. By varying model and tunnel speeds, a wide range of relative wind or yaw angles were simulated. A simple internal strain gage balance with conventional recording equipment measured the time history of the aerodynamic side force and yawing moment.

670794 (JL67-6-71) **Ammonia versus Hydrocarbons as Gas Turbine Fuels.** H. K. Newhall, University of Wisconsin; and E. S. Starkman, University of California. The use of ammonia as a gas turbine fuel, instead of a hydrocarbon fuel, should result in:

- More power (up to 10%) delivered for the same limited turbine inlet temperature.
- Higher thermal efficiency (also up to 10%).
- Poorer specific fuel consumption. Predicted sfc is 2½ to 3 times greater for ammonia.

The theoretical model employed in making the comparison was the Brayton cycle. Three cases were considered: ideal, nonregenerative; nonideal, nonregenerative; and nonideal, regenerative. Assumptions made were: products of combustion exist in a state of chemical equilibrium throughout the expansion process; effects of pressure loss through the combustor and heat transfer loss offset each other as far as relative performance parameters are concerned.

Reference fuel chosen was cetane ($C_{16}H_{34}$), a pure hydrocarbon whose composition is nearly representative of the average composition of turbine fuels now in use. Performance results predicted for ammonia are presented relative to those predicted for cetane, but should apply equally well to any C_nH_{2n} series hydrocarbon.

670795 (JL67-6-78) **Titanium Is Being Readied for Major Role in SST Design.** William H. Heil, Titanium Metals Corp. of America; J. R. Gannett and Ray Dixon, Boeing Co., Supersonic Transport Div. Developments in titanium technology are combining to make titanium as common on supersonic aircraft as aluminum is on subsonic aircraft. Among these are improvements in the titanium mill products and in the inspection and repair techniques.

670796 (JL67-6-80) **Elements Significant in Customer Attitude on GSE.** P. L. Williams and H. K. Hanchett, Northrop Corp., Norair Div. Customer acceptance of ground support equipment rests on hard-to-measure as well as on readily measurable aspects of established initial sale requirements and of the functional suitability of the equipment. The customer's attitude toward the total system will be shaped by his assessment of how well the system fills his needs.

Fourteen identifiable elements affect significantly a customer's attitude toward the ground support equipment he has purchased. These factors are: (1) cost, (2) complexity, (3) sophistication, (4) compatibility, (5) size, (6) weight, (7) power requirements, (8) suitability, (9) cooling requirements, (10) reliability, (11) maintainability, (12) availability, (13) configuration control, and (14) personnel training and equipment instructions.

670797 (JL67-6-82) **New Superairport Plan Provides: Better Facilities Now and Expansion Potential.** Rush F. Ziegenfelder and William H. Wilkinson, Jr., Parsons, Brinckerhoff, Quade & Douglas. The satellite concept for a superairport provides for a central transportation complex ringed with distant independent passenger terminals, thus providing flexibility to handle any foreseeable increase in air traffic.

Other advantages claimed for this new concept are separation of passenger and cargo operations both inbound and outbound, separation of service and supply from passenger movement, easy access and parking. The plan could be launched with one or a few satellites, and added to as needed.

670798 (JL67-6-88) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Because employees are also people, there will be times when they can benefit from the engineer's understanding, experience and advice. Questions and discussions can be initiated by either party at any time when both individuals are available.

670799 (JL67-6-89) **Best Electrical Materials for High-Temperature Uses Studied.** Paul E. Kueser, Westinghouse Elec. Corp., Westinghouse Aerospace Electrical Div. Electrical materials suitable for various high-temperature applications were examined and divided into three categories. These categories were based on the magnetic, conductive, and insulation properties of the materials. Temperature range considered was from 600 to 1600 F.

670986 (JL67-7-36) **CAL Computer Simulation Predicts Occupant Responses during Vehicle Head-On Collision.** Raymond R. McHenry and Kenneth N. Naab, Cornell Aeronautical Lab., Inc.; L. M. Patrick and H. J. Mertz, Jr., Wayne State Univ.; and C. K. Kroell, General Motors Res. Labs. Actual impact sled tests, with a dummy occupant, prove the basic validity of the Cornell Aeronautical Laboratory computer simulation of automobile occupant responses during a frontal head-on collision. In particular, it appears that:

1. The simulated and experimental time-histories show good agreement in timing of events, occupant kinematics, general levels of peak values, and waveform of responses . . . despite shortcomings in some of the parameter data and the limitations imposed by the simplified analytical representations.

2. Refinements are needed in the analytical treatment of torso and neck bending to produce adequate correlation between the calculated and the experimental acceleration versus time waveforms for moderate to high severity impacts.

3. The experimental responses for chest and head accelerations indicated greater linearity in bending resistance of the dummy torso and neck than that simulated.

4. The assumption of proportionality between tangential and normal forces on the honeycomb cardboard targets is not valid.

5. The analytical simulation of seat cushion friction was not adequate for the large vertical deflection of the seat cushion.

6. The actual, dynamic, vertical stiffness of the seat cushion is somewhat higher than that simulated, so the seat offered greater resistance to vertical hip movement than that simulated.

7. Load-deflection properties of the padding on the dummy structure under the lap belt were not based on a sufficiently large range of loadings.

670987 (JL67-7-46) **Techniques Planned to Minimize Time Required on Boeing SST for Unscheduled Maintenance.** Earl E. Carlsten, Supersonic Transport Div., Boeing Co. To insure maximum utilization of the highly complex supersonic transport, time required on the ground for unscheduled maintenance must be controlled and limited. To this end, two design approaches are being applied in the development of the Boeing SST prototype design, as follows:

1. Certain test and analyzing equipment, hitherto used on the ground, will be carried on the aircraft as permanently built-in features.

2. The aircraft systems are being modularized into line replaceable units, that is, units which are readily installed or removed.

Although some individual units are being provided with self-test capability, most testing and analyzing functions will be performed by an aircraft integrated data system. This will be fed with data from sensors located throughout the systems. The data will be scanned by a small computer to detect and isolate malfunctions. When a fault is isolated, the crew can radio ahead to have a replacement unit available on landing.

Aircraft integrated data system data will also be recorded for delayed computer processing on the ground—to provide wearout or maintenance trend data on equipment that has moving parts. With this type of support, the unscheduled maintenance will become predictable to a certain degree, and the time required for its correction will become relatively precise and even controllable.

670988 (JL67-8-47) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Encouraging employee development is a supervisory responsibility because of its long-run importance to the organization. A person can't learn for someone else, but another can influence his opportunity to learn especially if the other person is his supervisor.

670989 (JL67-7-48) **Thermal Stability of Jet Fuel Can be Maintained from Refinery to Aircraft.** L. P. Haxby, A. L. Ludwig, and G. F. Lawler, Shell Oil Co. The high-quality turbine fuel being produced today can be transported from refinery to aircraft through a complex distribution system with no loss in thermal stability. This fuel, which is well above the minimum specification limits for subsonic jets, is also expected to be suitable for supersonic aircraft.

Shell reached these conclusions after surveying the quality of its fuels at refineries and airports in the United States and Western Europe. Specification properties were determined on refinery storage fuels just prior to shipment and on field samples at the last point in the distribution system prior to aircraft loading.

670990 (JL67-7-50) **Army "Go Anywhere" Vehicles Almost Get There.** Cecil C. Umberger, Army Engr. Res. and Dev. Labs. Seeking a vehicle to operate on soil lacking the solidity to support conventional vehicles and containing insufficient water for amphibious operation, the U.S. Army Engineer Research & Development Laboratories have developed and tested four vehicle concepts. These are characterized as drum, drum-belt, track, and track-pontoon.

Design specifications called for the transport of up to three men with equipment, frontal armor protection against small arms fire, as well as limited range and life expectancy. The vehicle must also be inexpensive and be of a size and weight to permit simultaneous transportation of three of the vehicles within the bowels of a CH-47 helicopter.

670991 (JL67-7-52) **Exhaust Gas Emissions Related to Engine Combustion.** M. Alperstein and R. L. Bradow, Texaco Res. Center. Study of combustion-chamber formation of inorganic and organic materials found in spark-ignition engine exhaust reveals oxides

of nitrogen to be "flame-formed."

A limited amount of NO decomposition occurs in the post-flame period, but it is stopped from further decomposition by the rapidly falling gas temperature during the expansion stroke. The exhaust levels of NO represent a weighted average of these localized phenomena.

Organic exhaust constituents contributed by combustion-chamber slow-combustion reactions were found to include olefins, aldehydes, ketones, and ring ethers, when operating with isooctane fuel. Adding tetraethyl lead to the fuel inhibits slow-combustion reactivity, thus reducing concentrations of slow-combustion products in the exhaust.

To conduct the studies, use was made of a Waukesha CFR variable compression ratio, single-cylinder engine with multiport combustion chamber. Data were obtained with a 180-deg shrouded intake valve oriented to provide heavy swirl and good mixing, and with an unshrouded valve to obtain quiescent combustion.

670992 (JL67-7-54) **Magnetic Pulse Forming Offers Relatively High Repetition Rates with Simple Electronic Controls.** David F. Brower and Richard A. Ayers, General Atomic Div., General Dynamics Corp. Magnetic pulse forming occurs under a pressure produced by the interaction of the currents induced in the workpiece and the magnetic field. There are two control functions, a switch-off of charging current and a switching of charge to work coil. The process is readily adapted to production lines, due to its high repetition rates and use of existing electronic controls.

The advantages of magnetic pulse forming include:

- Control and measurement is purely electrical.
- Process is monitored by single voltage reading.
- Microsecond synchronization is possible using existing electronic controls and devices.
- Force is derived directly from magnetic field.
- Relatively high repetition rates are available as process is completely free of mechanical inertia.

670993 (JL67-7-56) **Shock, Vibration, Ride Dynamics and Suspension Are Main Factors in Ground Missile-Carrier Design.** J. J. MacRostie, FMC Corp., Ord. Div. Battlefield mobility of tactical missile and electronic systems imposes unusual demands on ground vehicle designers. Among the many important factors missile carrier designers must consider, three are of particular significance:

- Shock and vibration problems.
- Prediction of ride dynamics.
- Estimation as well as optimization of the suspension components data.

670994 (JL67-7-63) **New Hot-Sizing Dies Form Titanium Parts to Net Dimensions at 1450 F.** Stewart Paterson, Jr., Commercial Airplane Div., Boeing Co. Hot sizing dies can be precision cast by a technique that requires only hand cleaning on the working surfaces. The precision cast dies, made of Nicrosil or HH alloys, are capable of forming titanium parts to net dimensions at temperatures up to 1450 F. Modified Shaw Process molds are used to cast the dies to net dimensions. A formula permits calculation of the dimensions of the casting pattern when the desired dimensions of the finished part are known.

670995 (JL67-7-66) **Computer Allows Designer To Style Complex Surfaces, Complete Bodies–Without Models.** Walter L. Johnson, John W. Sanders, and Neil E. South, Metal Stamping Div., Ford Motor Co. Complex surfaces may be effectively defined and manipulated when described by a series of surface "patches," the equations of which are known. With electronic computation, variation of the input data allows the surface to be shaped at will. A 3-dimensional visualization may be achieved by employing the parallax effect. If coupled with real-time computation and visual display apparatus, the resulting instantaneous visualization would permit the designer to electronically sculp his surface. A complete simplified automobile body has been designed.

670996 (JL67-7-69) **Corrosion and Radiation Effects Must Be Minimized in Fuels for Automotive Turbine Engines.** Leonard Raymond, Mobil Oil Corp. Fuels suitable for automotive gas turbines must produce minimum high-temperature corrosion. Their radiation effects on metal surfaces should also be as low as possible. They must also satisfy fuel-injection systems, produce minimum deposits, and be available at a reasonable cost.

670997 (JL67-7-74) **How Fast Can Trains Go?** Marilyn J. Shilkoff, *SAE Journal*. Two trains—far apart in design approach—have both gone over 180 mph during tests.

- The French Aerotrain, which is well along in its tests, and is floating on air cushions toward reality. Passenger service between Paris and Orleans is coming. The first section of track for such a system—12½ miles long, 16 ft high, and looking like an inverted T—is going up for use as an advanced test track.
- The New York Central Railroad high-speed train, which consisted mainly of existing equipment. It used standard tracks and a standard Budd RDC-3 car, mildly modified—fitted with two J47 turbojet engines.

670998 (JL67-8-36) **Throttle Is Only Moving Part in Low-Cost Fluidic Carburetor.** Alan M. Binder, Hewlett-Packard Co., Sanborn Div. In the Binder fluidic carburetor a proportional fluid amplifier regulates the fuel flow to the engine according to the pressure differential between atmosphere and the pressure in the carburetor throat. Preliminary test results from a 1000-mile road test of a crude, hand-made carburetor indicate the significance of this new development.

The fluidic unit has many advantages over conventional, mechanically controlled, carburetors including:

- Simplicity. Fluidic carburetor has only one moving part–the throttle. There is no accelerator pump, float chamber, or mechanical linkages.
- Low cost. Design simplicity means low-cost mass manufacture. Maintenance costs are also reduced. Estimates indicate that it will cost less to replace a fluidic amplifier than overhaul a conventional unit.
- Freedom of mounting. As unit does not depend on gravity, the carburetor works at any angle, even upside down.
- Low air pollution. Eliminating the float bowl and accelerator pump cuts emissions.
- Increased reliability. This results from the eradication of such mechanical parts as floats and needle valves.
- Compatibility. No changes are required in existing engine fuel pumps or intake manifolds.
- Increased economy. No fuel is wasted by either an accelerator pump or by evaporative losses from the float bowl.
- Response within the amplifier to operator commands is immediate. On-the-car tests show no discernible lag in engine operation.
- No separate power source is required, as in electronic fuel injection.

670999 (JL67-8-39) **Proposed ATOL System May Make In-City Airports a Reality.** Charles J. Daniels, All Amer. Engrg. Co. The airport runway length now required by all commercial aircraft may be remarkably reduced by the application of present developments in assisted take-off and landing systems. Two new distinct classes of airport are proposed: a large suburban airport for jet aircraft, and small in-city airports for small commercial and STOL aircraft. The equipment necessary to these proposals has been developed and the modifications required to adapt it to commercial use defined.

671000 (JL67-8-43) **400-Bhp Engines Will Be Common on Trucks in Five Years.** William T. Deibel, Eaton Yale & Towne, Inc. Within the next five years, engines of 265–500 bhp (compared with today's 180–335 bhp) will be required for large over-the-road commercial vehicles. Units with 400-bhp engines will be commonplace.

The engines will be diesels (turbine types are not expected to become a major factor in this period), which will attain this increased power by some combination of:

- Increased displacement.
- Increased engine speed.
- Turbocharging.

The problems that will arise in matching transmissions to these higher output engines will be similar to those met in the past, only more difficult to solve. Although "dark horses," such as the hydrostatic and "hot-shift" transmissions, and the electric drive may enter the field, it is much more likely that the transmission developed for these engines will be based on the conventional types.

671001 (JL67-8-45) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. The role of meetings in accomplishing work is increasingly recognized. How well a meeting is planned and conducted is critical to its effectiveness. The first assumption to test is whether the meeting is needed in the first place.

671002 (JL67-8-46) **Four Proposed Tests Will Ensure Quality Control and Consistency of All Automotive Brake Linings.** A. R.

Spencer, Sr., W. M. Spurgeon, and J. L. Winge, Bendix Corp. A battery of four tests is proposed to control the quality and so maintain consistent properties in brake linings. Radiography and resinography complement each other in evaluating the mechanical structure of the lining. Differential thermal analysis determines the chemical composition of the organic resin binders and friction modifiers. A high energy input friction (drag) test (a modified SAE J661 test) pinpoints the functional frictional behavior of the burnished lining. Present quality control tests are also outlined.

671003 (JL67-8-51) **Electroluminescent Lighting Saves Weight and Watts on Apollo Command Module.** Charles D. Wheelwright, Manned Spacecraft Center, NASA; Harold N. Shonyo, North Amer. Aviation, Inc.; and George H. Kaelin, Symbolic Displays, Inc. Electroluminescent lighting is being used to provide transillumination (or backlighting) for the display and control panels and instruments of the Apollo Command Module. The result is a saving of several pounds of weight and several tens of watts, compared with conventional incandescent lighting.

In adapting this technique to meeting the panel and instrument lighting requirements of the Apollo Command Module, certain problems had to be solved:

- Maintaining brightness and color during lamp lifetime.
- Illuminating delicate meter-driven pointers.
- Avoiding the effect of high temperatures in reducing lamp life.
- Dimming.

671004 (JL67-8-55) **Red PbO Is Most Active Antiknock among TEL Decomposition Products.** L. B. Graiff, Wood River Res. Lab., Shell Oil Co. Tests in a motored CFR engine suggest that antiknock properties of tel come from its decomposition into three differing lead oxide forms. Red lead oxide with a distorted tetragonal crystal structure is the most active antiknock degradation product of tel. A mechanism to explain the action of tel is proposed.

671005 (JL67-8-60) **Mobile Powerplant Trends Forecast.** Harvey W. Welsh, Advanced Powerplants Committee, SAE Powerplant Activity. The reasons why it is difficult for a new type of powerplant to oust a long entrenched engine are listed. Then it is shown why otto-and diesel-cycle engines will continue to dominate their fields for the next 10–25 years. Also discussed are the prospects of the:

- Wankel engine–which may eventually take part of the small engine market.
- Turbine engine–which must have better part-load fuel economy before it becomes competitive.
- Free piston, stratified charge, PTC, and Stirling engines–which will be limited to specialized applications.
- Fuel cell and electric storage battery–which are the only direct converters having future competitive possibilities. Cost of materials must be lowered and their compatibility must be improved before the fuel cell becomes competitive. The zinc-oxygen battery could well replace the gasoline engine, in time, if the air pollution problem is not solved by other means.

671006 (JL67-8-64) **Occasional Overloads Cause Bolt Loosening.** Samuel K. Clark and Jerald J. Cook, University of Michigan. A definite functional relationship exists between the stress on a typical bolt, the oscillatory torque applied, and the number of cycles to loosening. The fatigue testing machine which was adapted to produce these results will allow more meaningful bolt design studies in the future.

671007 (JL67-8-66) **Chevrolet's V-8 "Turbo-Jet" Engine Designed Primarily to Increase Volumetric Efficiency.** Richard L. Keinath, Herbert G. Sood, and William J. Polkinghorne, Chevrolet Motor Div., GMC. To ensure that the new Chevrolet V-8 "Turbo-Jet" engine had high volumetric efficiency, its designers began by establishing the inlet and the exhaust port locations and their configurations.

Among the unusual design features which result are: valves tilted transversely and longitudinally, independent rocker arms, a wedge shaped combustion chamber located in the cylinder head, and a centrally located spark plug.

The resulting engine is available in 396 and 427 cu in. displacements, and as a 366 cu in. heavy-duty truck engine.

The engine design features are compared with a conventionally designed Turbo-Fire 409 cu in. engine.

671008 (JL67-8-70) **Unified Theory of Rubber Friction Reveals Adhesion Component's Role in Tire-Road Surface Coupling.** H. W. Kummer and W. E. Meyer, Mechanical Engrg. Dept., Pennsylvania State Univ. New unified theory of rubber friction suggests that adhesion and hysteresis are manifestations of the same energy dissipation process. Pavement design must optimize the adhesion coefficient if tire performance is to be improved. Increasing the frictional synchronization of the tire-tread elements also aids performance.

671009 (JL67-8-74) **Electric Trains Make Fast Tracks.** Marilyn J. Shilkoff, *SAE Journal*. The Japanese National Railways has been operating trains at 125 mph since 1964. Here, the Pennsylvania Railroad will run trains at 110 mph between New York and Washington, starting this October, raising their running speed to 150 mph in a few years. The Pennsylvania train was recently tested at 156 mph on a special test track.

Some of the advantages of electric self-propelled railcars are:

- They can be braked efficiently with dynamic brakes.
- They give high performance in acceleration and deceleration.
- They permit great flexibility in meeting load requirements.
- Axle load is uniform.
- Weights are comparatively light.
- They don't carry fuel on board.
- Terminal operation and equipment servicing are simple.

On the negative side is the fact that it is very expensive to electrify a railroad—and this could be a deterrent, unless there is sufficient money available, or a route is already electrified.

671010 (JL67-8-86) **No Lost-Time Injuries in 12,000,000 Miles of Police Car Operation.** J. L. Fulton, Police Traffic Bureau, Los Angeles Police Dept. The Los Angeles Police Department uses a double shoulder strap and lap belt combination in its police cars. Originally the anchor point for the shoulder harness was in the floor directly behind the front seat. When it was learned that this could cause damaging compressive stress on the spinal column, the anchorage was moved to a point behind the rear seat cushion for normal operation. When the rear seat is occupied, the strap is reconnected to the former floor anchorage.

671011 (JL67-9-34) **Smoke and Smell Reduction Are Major Diesel Exhaust Problems.** Miles L. Brubacher, California Motor Vehicle Pollution Control Board; W. B. Millington and C. C. J. French, Sr., Ricardo and Co. Engineers (1927) Ltd.; Robert C. Schmidt, Roy Kamo, and Al W. Carey, Cummins Engine Co., Inc. Automotive diesels operate well within the California maximums for unburned hydrocarbons and carbon dioxide. This is not true, however, for the maximum established but not yet mandatory for oxides of nitrogen. Since there is no readily available way to reduce the output of these oxides significantly by engine modifications, control devices such as catalytic mufflers, scrubbers, and dilution means would be required. The problem presented by these oxides needs careful study since some research suggests that photochemical smog might actually be increased by reductions in the concentration of nitrogen oxides.

The foregoing points to the conclusion that for diesel-powered vehicles, smoke and odor are the major problems both here and in Europe. The photochemical type of smog which plagues Los Angeles is not regarded as a problem abroad. In London, smog is characterized by a high content of smoke, sulphur compounds, and such. It is primarily a winter problem, occurring on cold misty days, and is rare during a temperature inversion. In the event of an inversion in summer, there is insufficient sunlight to produce photochemical smog.

Much has been accomplished by engine manufacturers to reduce smoke density in the last 35 years. A smoking diesel costs more to operate and hence economics have been exerting steady pressure for improved combustion efficiency.

671012 (JL67-9-38) **Is Your Company Sharing in Government-Developed Technology?** D. A. Douglas, Jr., Union Carbide Corp., Stellite Div.; and James E. Burnett, Lewis Research Center, NASA. For their own benefit and protection, the companies which comprise United States industry should utilize to the fullest the technology developed for government projects.

The contemporary technological revolution has created a new climate to which

each industrial organization must adjust or suffer. Technology has become important to the future economic and commerical growth of most companies. So, most companies would be wise to recognize and utilize one of our country's most valuable resources—the government technology stockpile. To do so is neither cheap nor easy. But the government agencies (like NASA) producing the new technologies are doing their best to make the new developments available. They are building practical bridges over which, it is hoped, these technologies can be transferred to individual companies.

671013 (JL67-9-40) **Aircraft Parts Survive Jungle Erosive Environment.** A. B. Billet, Aerospace Div., Vickers, Inc., Div. of Sperry Rand Corp. If military equipment designed for worldwide environments can be sealed or partially sealed, its chances of surviving long-term exposure to the elements will be excellent.

This conclusion has been reached on completion of the third stage of an investigation which included the jungles of Panama to examine fallen aircraft, following similar excursions to the North African desert and the Greenland icecap.

As a result of these environmental studies, it is believed that military specifications for shelf life of hydraulic O rings can be lengthened from the present 24–36 months to 5 years and, perhaps, with further information to 7 years.

671014 (JL67-9-42) **Demand Valve Switches Flow from Steering to Implement Circuits in Articulated Vehicle.** Thomas J. Malott and Robert C. Westveer, New York Air Brake Co., Hydreco Div. General steering requirements and the specific power demands of articulated vehicles on the hydraulic circuit are analyzed by studying valve and vehicle cycles. The resulting circuit design gains its superior performance by splitting the single implement pump into two separate units whose total output fulfills implement power demands.

671015 (JL67-9-47) **Test Rig Measures Heat Transfer of Various Piston Cooling Methods.** Arthur Stotter, Israel Institute of Technology. The effectiveness of various methods of cooling pistons in internal-combustion engines are evaluated experimentally in a new rig. Numerical values of heat transfer coefficient are obtained for no oil cooling, cooling from a pressure lubricated small end, jet cooling, and cocktail shaker cooling of the piston.

Besides obtaining values of heat transfer coefficient, which may be used to predict piston cooling, it was concluded that;

- Favorable cooling effect is available from oil leakage from the connecting-rod small end.
- More fundamental design approach is required for jet type cooling.
- Optimum rate of oil supply exists in cocktail shaker cooling.

671016 (JL67-9-49) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Because a supervisor must deal with policies and procedures, he has to understand their purposes and functions. They are highly useful guides when properly understood and used.

671017 (JL67-9-50) **Car Body Aerodynamics Play an Important Role in Heater Air Flow.** Ricklef W. Shirk, Chrysler Corp. Heater air flow rate is a function not only of the heater itself but also of the size and location of the heater air inlets, the car body air outlets, and the body surface pressure at these openings. Little consideration has been given to body air outlet pressure conditions since body leakage paths have generally served as adequate air outlets.

But as the car body is made leak-proof to dust, water, and air, it becomes necessary to consider specific air outlets. To judiciously size and locate these outlets a knowledge of car body aerodynamics is essential.

671018 (JL67-9-55) **Engines Use Some Cylinders as Air Compressors to Unload Truck Bulk Cargoes.** Robert C. Schmidt, Cummins Engineering Co., Inc. Engines capable of using some cylinders as an air compressor eliminate the frame mounted auxiliary compressor used to unload bulk cargo. In practical installations one valve switches the cylinders from drive to compressor operation without stopping the engine. Airflow is such that one ton per minute can be unloaded.

Engines with both the diesel and air compressor cylinders within the same engine framework have been available for some time. The switching of a cylinder or groups of cylinders back and forth from diesel to compressor action within the same engine frame is new. This switchover is made without stopping the engine.

The dual diesel has distinct advantages over the frame mounted auxiliary compressor, including:

- Simplicity—fewer total parts.
- Lower tare weight hence greater cargo weight.
- Lower cost as the auxiliary compressor is eliminated.
- Simplified (integral) maintenance.
- Increased reliability.
- Faster unloading with increased pressure.

The lighter vehicle weight is critical in dry cargo hauling as most cargoes, such as cement, are limited by weight rather than volume. A reduction in vehicle weight increases the vehicle's cargo carrying capacity.

671019 (JL67-9-58) **Brake Proportioning Valves Improve Braking Response.** Robert J. Morse, Bendix-Westinghouse Auto. Air Brake Co.; Robert T. Eddy, Sr., Brake & Steering Div., and Robert A. Wilson, Research Laboratories Div., The Bendix Corp.; William C. Eaton and Ivan Schreur, Midland-Ross Corp. Two simple techniques produce substantially improved braking response:

- Basing brake power calculations on the dynamic weight transfer existing at 0.3 *g* decelerations which improves the braking characteristics of laden vehicles.
- Using a load proportioning valve system, which improves the response of unladen commercial vehicles.

A typical brake proportioning valve for large commercial vehicles has a control unit and a choice of actuators to allow use with both air and mechanical suspensions. A valve intended for cars and light commercial vehicles has a spring sensing system detecting both dynamic and static loading.

Most present braking systems are designed on a system pressure of 60 psi and a 0.6*K* factor. *K* is the ratio of retarding force to weight.

671020 (JL67-9-66) **New Apparatus Measures Friction Characteristics of CSD Lubricants.** M. L. Haviland, M. C. Goodwin, and J. J. Rodgers, General Motors Corp., Res. Labs. The R-H Friction Apparatus simulates Controlled-Slip Differential clutch plate sliding in the laboratory. The results correlate closely with car test findings and indicate the improvements necessary in the additives.

671021 (JL67-9-72) **New Concept Joins Man to Machine to Perform Gigantic Tasks.** Ralph S. Mosher, General Electric Co., Research and Development Center. Walking, lifting, climbing, pushing and pulling 1500 lb, or carrying payloads of 500 lb over rough terrain at 5 mph without exerting more than normal human effort will be possible for man in the not too distant future with the aid of the Cybernetic Anthropomorphous Machine, known as CAM.

The CAM employs manipulators to extend and augment man's capabilities in those tasks that require judgment and control. Man's sensory assets and his complex manipulative ability guide the machine. The ability and efficiency of the manipulator depend on effective cybernetics, or the adequate transmission of human sensory information between the operator and the task. Manipulative dexterity, proprioceptive position, kinesthetic force, and visual and audio sensing are all factors to be included in a meaningful extension of man's capabilities.

671022 (JL67-9-76) **Saturn IB Launch Vehicle Can be Uprated to Handle Missions of the Future.** David N. Buell and Albert S. Schnyder, Chrysler Corp., Space Div. Versatile space missions of the near future require an equally versatile launch vehicle. But these missions do not warrant the development of a complete vehicle of new design. Versatility must be achieved through relatively inexpensive add-on devices for a flight proved launch vehicle such as the Saturn IB.

NASA and Chrysler Space Division studies show that the Saturn IB launch vehicle can be uprated by:

- Propellant additives.
- Uprated engines.
- Thrust augmentation.
- Additional stages.

The usefulness of these techniques in extending the capabilities of the Saturn IB for accomplishing a series of potential missions was also studied.

671023 (JL67-9-83) **Is There Just One Tractor in the Farmer's Future?** Robert H. Tweedy, United States Steel Corp. Two new farm vehicles are proposed by U.S. Steel. These

vehicles, Vantage and Venture, should increase the farmer's equipment and labor investment by being flexible and serving multiple uses.

Vantage is an unusual tractor which:

- Alone forms an excellent drawbar tractor.
- With mounted implements forms a unit competitive with the comparable self-propelled implement.

Venture is a self-propelled farm wagon with sufficient advantages to displace both present farm-haulage systems, namely, road trucks and tractor-drawn wagons.

These concept designs are complete only to the point of indicating functional and engineering feasibility.

671024 (JL67-9-90) **Future Tractor and Earthmover Aim for Increased Productivity.** Harvey O. Jensen, Purolator Products, Inc. Off-the-road vehicles of the future must be designed to improve both vehicle and operator efficiency. Some common trends, aimed at attaining this goal, are clear in the two future vehicles envisioned by Purolator Products, Inc. The vehicles are:

- A large 3-wheeled tractor.
- A rubber-tired bulldozer.

Both have increased size, improved operator environment, and are designed for easier maintenance.

671025 (JL67-10-36) **Driver's Chances of Survival in Head-On Crashes Improve with Energy-Absorbing Steering Column.** Donald P. Marquis, Saginaw Steering Gear Div., GMC; Paul C. Skeels, General Motors Proving Ground; and Harlan L. Hanson, American Motors Corp. The development of the Saginaw energy-absorbing steering column that is installed in 1967 General Motors and American Motors cars was accomplished over a period of 6 years. During this time a number of designs were evolved, each of which displayed limitations that were eliminated in the next attempt. These included the Invertube and the Japanese Lantern column. Finally, the energy-absorbing column with the diamond-shaped mesh that is now in production was worked out.

The success of this final design in saving human lives in actual accidents has already been demonstrated.

671026 (JL67-10-43) **Computer Aids Automated Design of Complex Automotive Parts.** James M. Sneyd, Physics-Instrumentation Research, Chrysler Corp. Automated design implies a complete computer program that can predict the performance of a concept design and evaluate it against some figure of merit or objective criterion. The program must then modify the design concept in a direction that improves the performance, continuing this process in an iterative mode until an optimum design has been found. The technique can be used to solve such problems as:

- Design of 3-bar truss with two loading conditions.
- Elimination or isolation of propeller shaft vibrations.
- Kinematic designs.

671027 (JL67-10-44) **To Succeed, Managers Must Use Resources to Advantage.** Francis M. Webster, Chrysler Corp., and Robert B. Alexander, Ford Motor Co. A manager may well be defined as "one who administers and directs to the best advantage of the organization he is responsible for managing. To fulfill his obligations, he must manage to the best advantage a variety of resources, including money, people, time, information, "image," and facilities, equipment, and material resources.

671028 (JL67-10-45) **Restraint Harness Standard Has Socio-Engineering Basis.** Harry E. Chesebrough, Chrysler Corp., Product Planning and Development. The new Federal standard for car-occupant restraint systems is a good example of the interaction between the automobile engineer and the spokesman for society. The mandated installation is a social standard; engineering pertains only to the details of the installation.

The only fully successful occupant-restraint system, in terms of occupant usage, for passenger cars will be one that requires no overt action on the part of the user. Such a system must also be unobtrusive when not in use. Unfortunately this ultimate system has not yet been developed.

671029 (JL67-10-46) **New Protective Coatings Allow Use of Refractory Metal Alloys in Reusable Reentry Vehicles.** Seymour Priceman and Lawrence Sama, Sylcor Div., Sylvania Electric Products, Inc. Fused silicide coatings can protect reusable reentry vehicle components made of columbium and tantalum alloys from the high-temperature oxidizing environment encountered during reentry. (These alloys have good high-temperature mechanical properties, but notoriously poor high-temperature oxidation resistance.)

These oxidation resisting coatings have the basic properties to protect columbium and tantalum parts for many reuse cycles, as follows:

- They can be uniformly applied to any size and shape, no matter how complicated; they will even adhere to contaminated surfaces.
- They display the required oxidation resistance under the conditions of temperature and pressure that the reentry vehicle will encounter.

671030 (JL67-10-53) **"So You'd Like To Be a Supervisor."** James E. Boyce, General Motors Corp. Maintenance of morale and motivation is similar to leadership in that many aspects of the job situation contribute to it. There is extensive interest in, and research on, these subjects. Like happiness, they cannot be sought directly, but are by-products of other activities. In one sense, therefore, you can't motivate another person; you can only appeal to his internal motivation. The article discusses points that should help clarify some of those terms whose meanings are almost as broad as their use.

671031 (JL67-10-54) **Controls Adjusting Variable Geometry SST Inlet Are Vital to Commercial Flight.** Robert D. Porter, Hamilton Standard Div. United Aircraft Corp.; and J. R. Moorehead, Boeing Co., SST Div. The variable-geometry air inlet for a supersonic transport, such as the Boeing SST, is described. Its duct walls are movable to accommodate the varying inlet air speed effectively. Bypass doors let out excess air.

Operation of the cowl and centerbody, which form the convergent-divergent duct, and the bypass doors is explained. The problems of unstart, restart, and noise supression are mentioned briefly.

The automatic controls for regulating the centerbody and bypass doors operate on the closed-loop principle. The heart of these controls is the primary loop pressure ratio sensor, which is described in some detail. Auxiliary controls needed for automatic and emergency control under all anticipated operating conditions include the Mach sensor, restart control, and buzz sensor, which are also mentioned briefly.

671032 (JL67-10-60) **Interim Goals Report Practices "The Art of the Possible."** Norman G. Shidle, *SAE Journal*. The Interim Report of the Commitee on Goals of Engineering Education of the American Society for Engineering Education continues most of the recommendations revealed in the earlier Preliminary Report. But IR is couched in language more likely to make its contents acceptable to both industry and academic critics. IR's recommendations *sound* like recommendations not dicta. IR discussions leading to recommendations evaluate fully *all* the conditions—including those which might have led others to different conclusions.

The handling of recommendations for five-year curricula—clearly a "must" in both Preliminary and Interim Reports—is typical of the more objective approach of the latter.

671033 (JL67-10-62) **Lower Oil Viscosity, Boost Fuel Vapor Pressure to Ease Cold Starting.** R. M. Stewart and W. A. P. Meyer, Gulf Research & Development Co. In tests, oils with low viscosity permit easier starting of cars at −10 F. The other predominant factor affecting starting is fuel vapor pressure. Consistent misfiring of certain cylinders causes a "start but not run" condition which is common to all cars.

671034 (JL67-10-64) **Automatic Subsystems Improve Boeing H-46 Helicopter Handling.** Edward B. Schagrin, Vertol Div., Boeing Co. Control of the Boeing H-46 tandem rotor helicopter is achieved by varying the collective pitch of the rotors in the pitch and vertical axes and by cyclic pitch variations in the roll and yaw axes. The hydromechanical control system, linking the cockpit and the rotors, has dual upper and lower irreversible boost actuators. Four separate subsystems are incorporated to improve the aircraft's handling qualities. Differential collective pitch trim and longitudinal cyclic pitch trim are provided as a function of airspeed. The stability augmentation system (SAS) ensures good stability characteristics without the sophistication of an autopilot, which is relegated to the role of optional equipment. The optional autopilot, fitted to

the military H-46 versions, does not stabilize the aircraft. The autopilot is merely used with SAS for long term trimming.

671035 (JL67-10-69) **External Cushion Eliminates Dump Cylinder Failures in All-Hydraulic Skooper.** Charles L. Fleming, Koehring Co., Koehring Div. The novel dump cylinder design on Koehring Model 445 all-hydraulic Skoopers eliminates cylinder field failures due to surge pressures and mechanical bumping. The new design, featuring an external cushion, reduces both cushion and rod stress and eliminates rod stress reversal. An intermediate development step, which modified the existing design, failed because of excessive hydraulic shock loading.

671036 (JL67-10-72) **It's the Small Power Gains that Win Grand Prix Races.** Walter T. F. Hassan, Coventry Climax Engines Ltd. and Jaguar Cars Ltd. It is the small incessant power increments developed in an engine which win Grand Prix races. The 1961-5 1.5-liter Coventry Climax engines show how such power increases are gained. Mk I and II engines had a 90-deg phased crankshaft and a complicated tuned exhaust linkup. By switching to a 180-deg phased crankshaft and fuel injection for later models, further power rises were obtained. To reduce valve gear inertia two 4-valve engines were built again boosting power.

All units are designed to a specific philosophy. Studying engine performance relative to the various Grand Prix circuits shows that the car operates at maximum rpm and power for only a short time compared with that spent accelerating to this maximum. The most successful engine, therefore, combines a good maximum power with exceptional torque spread over at least 2500 rpm or, preferably, 3500 rpm.

It is impossible to get torque characteristics in the middle speed range if the valves and ports are sized to produce the highest maximum power. The Coventry Climax approach uses the smallest valves and ports from which adequate power can be obtained. Maximum torque now develops below the speed of maximum power. Further, the high compression ratio compensates for the slight lack of breathing at maximum speed.

671037 (JL67-10-79) **Lower Power Use and Operating Temperatures Give 2-Ply Tires the Edge.** Robert F. Bogan and William J. Dobie, Uniroyal, U.S. Rubber Tire Co. In laboratory tests, 2-ply tires are superior to their 4-ply counterparts in such areas as: power consumption, operating temperature, cornering force, and self-aligning torque.

Further, fewer failures are experienced by 2-ply tires in both extensive test-track and on-the-road studies.

671038 (JL67-10-82) **The Next 20 Years: Sharp Rise Predicted for Nonmetallic Car Materials.** Dr. Sumner B. Twiss and Norman P. Phillips, Chrysler Corp., Chemical Div. Nonmetallic materials will be used more and more in American cars over the next 20 years. These materials include various plastics and foams; glass; rubber, organic coatings; friction materials; adhesives, sealants, and deadeners; and miscellaneous chemical products.

More steel and iron will be used, too, on a total consumption basis, by the automotive industry in the next two decades. The amount of steel in an individual car, however, will probably decline slightly. (This is assuming, of course, that no major design breakthrough is made in this period in the use of plastics; otherwise the steel decline will be more drastic.)

The point, though, is the greater use of nonmetallic materials that is expected. Of the nonmetallics, only organic coatings and such miscellaneous chemicals as lubricants and greases are, on a unit basis, expected to show a decline. This, for organic coatings, will most likely be due to the use of thinner coats and the more extensive use of glass and colored plastics. The use of greases, lubricants, brake fluids, and so on, will also be influenced by the use of plastics, but mainly by more efficient engines and braking systems.

671039 (JL67-11-36) **Europeans Seek Better Lighting.** K. J. Jones, Joseph Lucas (Electrical) Ltd. Dissatisfied with present daytime turn signalling and with the vision given by headlights on separated highways, Europeans are taking a fresh look at the problems of lighting.

In the United Kingdom, amber is now required for both front and rear turn signals, experience having shown better differentiation between stop and turn than with the all-red system. Study of light intensities proves that a satisfactory daytime rear signal becomes intolerable at night, and this has led to two concepts:

- Front and rear signals can have different intensities.
- There should be a two-level system for rear signals to be adequate for both day and night.

Intensity values for both single and dual-level systems have been specified for the United Kingdom and similar values are being considered internationally by a working party of the Economic Commission of Europe, prior to drafting regulations.

671040 (JL67-11-40) **Structural Design of Reusable Horizontal-Launch Vehicles for Manned Orbital Operations System.** Allen I. Bernstein and Melvin A. Price, North Amer. Aviation, Inc. Rapidly changing environments influence the structural design and materials required for manned horizontal-launch reusable vehicles of future orbital operations systems. In designing these structures, four important factors must be very carefully investigated:

- Mission requirements.
- Structural design criteria.
- Structural characteristics.
- Pacing technology problems.

671041 (JL67-11-46) **Understeer, Characteristic Speed Measured by Three Tests.** R. Thomas Bundorf, General Motors Corp. Three tests measure understeer quality and characteristic speed, or the amount of understeer, as defined in SAE J670a, Vehicle Dynamics Terminology (see Box). The three tests are: constant turn radius, constant speed, and constant steer angle.

Although the definition of understeer applies throughout a broad range of operating conditions, the following discussion of handling characteristics is limited to linear operations and steady-state behavior.

671042 (JL67-11-49) **Two V-8 Engine Crankshafts Fitted to Central Drive Gear Form Flat-16 Engine Crankshaft.** Walter T. F. Hassan, Coventry Climax Engines Ltd., and Jaguar Cars Ltd. Two existing V-8 crankshafts plus oil pressure to shrink-fit them to opposite sides of a central drive gear produce one crankshaft for the Coventry Climax flat-16 engine.

671043 (JL67-11-50) **Parking the Big Boeing SST Shouldn't Be a Big Problem.** J. R. Gannett and Ray Dixon, Supersonic Transport Div., Boeing Co. Parking the Boeing 733 SST should present not unusual problems–except the need to allow for its additional length. Four possible parking arrangements are shown.

671044 (JL67-11-52) **LPG Shows Superiority over Gasoline as an Engine Fuel.** R. A. Mengelkamp and A. C. Hudson, Phillips Petroleum Co.; G. J. Kuivanen, R. O. Westra, and D. G. Lien, Minneapolis-Moline, Inc.; M. C. Baxter, Cities Service Oil Co.; W. L. Harris and J. W. Hummel, Dept. of Agricultural Engrg., University of Maryland; and W. S. Blalock and R. N. Little, Marvel-Schebler Div., Borg-Warner Corp. With a V-6 engine running at wide open throttle on liquefied petroleum gas (LPG), there was a 1.4% loss in horsepower. The comparison is with the same engine running on gasoline. On the other hand, there was a 12% improvement in brake specific fuel consumption (bsfc). Better fuel economy is one advantage that LPG offers over gasoline.

LPG burns cleaner than gasoline, too. It produces much less carbon monoxide and hydrocarbons in the exhaust, particularly at idle and light load.

Many LPG engines are field conversions of standard gasoline engines. Commercial carburetors and related fuel systems that are used in most LPG engines do not give optimum air-fuel ratios throughout the normal range of operating speeds and loads. Such deficiencies in carburetion harm the performance of LPG as an engine fuel. LPG performance can be improved, to at least match the power performance of its gasoline counterpart, by lowering fuel mixture temperatures. In one instance, power was increased some 10% with an "air type" converter utilizing the latent heat of vaporization of LPG.

671045 (JL67-11-58) **Two Independent Studies Show Reductions in Total Hydrocarbons Not Mirrored by Other Emissions.** P. E. Oberdorfer, Sun Oil Co.; and Wayne A. Daniel, General Motors Res. Labs. That "changes in the concentration of total or individual exhaust emissions do not necessarily reflect, even directionally, the concentration shifts of

other components" is exemplified by two distinct studies:

•Car tests—conducted by Sun Oil Co.—show that reductions in hydrocarbon exhaust emissions, due to air-fuel ratio changes, can correspond to increases in aldehydes.

•Single-cylinder engine tests—run by General Motors Corp.—show that, when using propane fuel, decreases in the total hydrocarbon level can be accompanied by increases in individual exhaust emission components.

671046 (JL67-11-62) **Full-Scale Collision Experiments Provide the Basis for Correcting School-Bus Safety Deficiencies.** Derwyn M. Severy, Harrison M. Brink, and Jack D. Baird, Institute of Transportation and Traffic Engineering, University of California. Three full-scale collision experiments involving school buses loaded with dummies representing children of various sizes show that these buses have many deficiencies as far as safety is concerned. They involve the structure of the bus itself, the interior, the seats, and the passenger restraints. In each case, however, knowledge of the deficiencies is used as the basis for specific suggestions for designing school buses so that passenger injuries during collision will be reduced.

671047 (JL67-11-69) **Acute Pollution Problems Still Face Automotive Engineers.** Arthur C. Stern, National Center for Air Pollution Control, Dept. of Health, Education, and Welfare. Motor vehicles are a major source of pollutants, accounting for 85,000,000 tons yearly. Department of Health, Education, and Welfare policy is to have national standards reflect the degree of controls needed to protect air quality in the most seriously affected areas.

671048 (JL67-11-72) **Two Methods Show Promise for Evaluating Scavenging Efficiency of Two-Stroke-Cycle Engines.** Richard R. Booy, Outboard Marine Corp. Two of the more promising experimental techniques for evaluating scavenging efficiency of 2-stroke-cycle spark-ignition engines are gas sampling and spark interruption. Both rely on indirect measurement of the various scavenging parameters.

The gas approach is somewhat more direct than the skip-cycle method, as it excludes from the analysis all effects except those assignable to the scavenging process itself. But it is limited to engine speeds below 4500 rpm. There is also the problem of getting an accurate analysis from two gases mixed at greatly different temperatures.

Spark interruption is not sensitive to engine speed. It requires, however, a laborious determination of indicated mean effective pressure from pressure-time diagrams converted to pressure-volume diagrams or from brake and friction horsepower data. And large quantities of combustible exhaust must be disposed of when an engine cycle other than the normal 2-stroke cycle is used.

671049 (JL67-11-76) **Main Bearing Forces Calculate More Accurately When Crankshaft Is Assumed Elastically Supported.** W. Gross, FAG Kugelfischer Georg Schaefer & Co.; and A. W. Hussmann, Technische Hochschule, Munich, Germany. A new, more accurate computation method predicts the forces in the main bearings of multicylinder engines more accurately than present methods by considering the shaft as a beam on elastic supports. Measurements of the bearing forces in two 6-cyl diesel engines proves the method's superiority over conventional techniques, particularly at high speeds where inertia loads dominate.

671050 (JL67-11-80) **Dynamic Testing Yields Realistic Vibration Mount Spring Rates.** Robert T. Larsen, Outboard Marine Corp. Dynamic testing is much more effective than static testing for determining realistic values of spring rates of vibration mounts for isolation systems.

Two methods of dynamic testing are: (1) the resonant beam dynamic tester, which gives resonant frequency, force input, and amplitude, from which dynamic spring rate and damping coefficient can be obtained; and (2) a nonresonant method, which uses the MB TM-6 Universal Testing machine. It allows a preload (or static load) to be imposed before the system is dynamically cycled from that point.

Forces acting on the mounts of a typical outboard motor isolation system are shown.

671051 (JL67-12-36) **1968 Passenger-Car Engineering Trends.** Walter G. Patton, *SAE Journal*. Engines for the 1968 passenger cars have been designed with emphasis on emissions as much as horsepower and fuel consumption. The trend is away from using an air pump or air-injection system to engine modifications to reduce emissions to the point where they fall within present government regulations.

Automatic transmissions have been recalibrated for greater torque multiplication and more part-throttle downshifting. Drive assemblies are generally sturdier, to handle the higher torque outputs of the larger engines.

Rear suspension geometry has been changed to improve car handling; curved strut gives more fore-and-aft front suspension complicance.

The trend is toward single-piston, floating-caliper disc brakes. Drum brake refinements include a convex shoe and riveted linings.

Among the new safety features is the fuel tank that resists rupturing, even under fairly severe impact.

671052 (JL67-12-60) **Bending Moment May Be Increased 50% After Wrinkling First Occurs in Large Thin-Walled Cylinders.** Robert P. Miller and Theodore F. Gerus, Lewis Res. Center, NASA. A long thin cylinder was subjected to constant compressive and shear loads until bent beyond the onset of compressive wrinkling. Tests on an Atlas booster showed that:

•The ultimate bending moment capability of a thin-walled pressure-stabilized cylinder with typical axial loads is at least 50% greater than the bending moment at which compressive wrinkling first occurs.

•Measured values of vehicle deflection and longitudinal wall stress correlate well with values calculated with relatively simple theory.

•Wrinkles up to 0.15 in. deep and extending over 180 deg of the tank circumference can be tolerated without yielding or permanent set. Wrinkles were also shown to pass beneath welded attachments without causing damage.

In many present applications, the ultimate strength of thin-walled cylinders is considered reached at the onset of wrinkling.

671053 (JL67-12-67) **Plastic Fiber Optics—New Design Tool of Auto Industry.** Robert A. Meade, Packard Elec. Div., GMC. Plastic fiber optics materials in wire form are being used in various lighting and remote indicating systems of some of the 1967 cars. These applications yield many major benefits, especially when steps are taken to optimize them. Improved performance capabilities, however, and more sophisticated handling techniques will be required before full utility can be derived.

671054 (JL67-12-73) **Vehicular Communication Research Continues on Additional Fronts.** Fred Bauer, Ford Div., Ford Motor Co.; and Rawley Emery, Bureau of Public Roads. Two systems that should improve vehicular communications and thus aid highway safety are discussed:

•A system of data input to vehicles, which informs drivers of road conditions ahead. Two unique features of this system (designated Radio Road Alert by its developer, Ford): central traffic control and central control of maximum vehicle speed, are described.

•An address coding system capable of indicating precisely the location of a vehicle within a highway network. This system, which is being developed by the Bureau of Public Roads, is based on the nodes and branches of highway networks. An alphanumeric format using five characters for naming nodes seems as if it will provide maximum information.

671055 (JL67-12-76) **A European View of "Pop-Out" Windshields.** G. Rodloff and G. Breitenburger, Deutsche Tafelglas AG. A perfect windshield must not be penetrated from the inside; deceleration forces arising from impact must be small; and the windshield must not become "blind," nor should it be penetrated by stones from the road. These requirements are met only by laminated safety glass.

The perfect windshield must fulfill the following conditions:

•The windshield should not have a rigid mounting and should not be cemented.

•Design of the "loose mounting" should insure that only the windshield "pops out," and not the rubber profile which should remain in the frame as a protection against the sharp edges of the vehicle body.

•The laminate configuration should be asymmetrical, the inner layer not exceeding a thickness of 0.071 in.

•The interlayer thickness must be selected in accordance with internal automobile dimensions and method of mounting.

671056 (JL67-12-78) **Business Jets Get**

Cooled Blades. Howard A. Buckner, Jr. and Robert R. Van Nimwegen, AiResearch Mfg. Co. of Arizona; Frederick W. Garry, Flight Propulsion Div., General Elec. Co.; and W. W. Jones, Allison Div., GMC. Business jet service life is being improved by new stator and rotor blade designs incorporating a combination of film and convection cooling. Cooling permits higher gas cycle temperatures while maintaining lower and more uniform metal temperatures.

671057 (JL67-12-80) **Automated Molding with New Glass-Reinforced Plastics Can Produce High-Quality Parts.** A. J. Tiffan, R. G. Cunningham, and J. A. Waters, Jr., Sohio Chemical Co.; James P. Walton, Chemical Div., United States Rubber Co.; and H. Stuart Alspach, Jackson Ohio Div., Goodyear Aerospace Corp. Three new glass-reinforced plastic molding materials have been developed specially for automated molding operation, with its opportunities for mass production of parts. They are available in sheet form, ready for molding without further ado, except for cutting to the proper charge weight or shape.

All three materials are produced with an even distribution of glass fibers throughout, which is maintained in the final molded product. As a result, parts of much more uniform quality, compared with premix and preform glass mat moldings, can be produced. The surface is smoother, and therefore more resistant to weather, chemicals, and abrasion, and it requires little or no preparation before painting.

Matched-die molding operations can be used, to produce parts containing undercuts, and which, in general, are much more complicated than when the preform process is used. In all cases there is little or no waste.

The three materials are:

- Sohio Structoform reinforced plastic.
- U.S. Rubber Vibrin-Mat molding compound.
- Goodyear Spraypreg material.

671058 (JL67-12-84) **Engineering Problems Lose Races Even When Engine Has Power To Win.** Walter T. F. Hassan, Coventry Climax Engines Ltd., and Jaguar Cars Ltd. In the early stages of its development, Coventry Climax's 1.5-liter V-8 engine was losing races not for lack of power but because of engineering problems. Differential expansion of the cylinder liners and block failed the sealing ring and caused overheating. Power consuming oil churning in the sump was cut by copper gauze screen installation. Fuel contamination fouled lines and cut off flow to the fuel injection metering unit. Transistor failures caused a no-go condition after the engine was switched off.

671059 (JL67-12-86) **Coninuous Airplane Operation under IFR Could Halve Airplane Accident Rate.** George S. Schairer, Res. and Dev., Boeing Co. The current airplane accident rate could probably be cut in half if all airline airplanes and other aircraft using the airways were always operated under instrument rules. Certainly such a system has its disadvantages: it is a chore for the crew to operate under IFR; traffic handling capability of airways and airports is seriously restricted; and scheduled flight time would be greater (comparing present visual rules with present IFR).

But these disadvantages seem small, when we consider that most recent accidents have been navigational, that is, the airplane was functioning normally, but it hit something that could have been avoided if vertical and horizontal navigation had been better. Some navigational accidents even occur in good weather; some occur when the pilot switches from IFR to visual flying rules under marginal weather conditions.

SAE JOURNAL AUTHOR INDEX

SAE JOURNAL—JANUARY THROUGH DECEMBER, 1967—VOL. 75

A

Adams, C. L.
New Navy monopropellant simplifies torpedo propulsion, handles safely
JL67-5-61 670778

Aitken, M.
World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Alexander, R. B.
Ground rules for success as a manager
JL67-10-44 671027

Alford, J.S.
Jet engine in high-speed stall can stall other engines in cluster
JL67-3-48 670430

Alperstein, M.
Nitrogen oxides found in spark-ignition engine exhaust are flame-formed
JL67-7-52 670991

Alspach, H.S.
Three new glass-reinforced plastics are available in sheet form, ready for molding. Matched-die molding operations can be used
JL67-12-80 671057

Alther, G. A.
Simple, light muffler with low back pressure cuts noise in light aircraft
JL67-5-58 670777

Anderson, K. W.
Change to narrow-row spacing will have modest impact on tractor design and usage
JL67-5-45 670771

Anderson, R. L.
Four factors affect aircraft spark-plug operation
JL67-4-80 670765

Auzenbergs, E.
Improved reporting is giving top management the brief, factual, financially oriented information needed to make sound decisions promptly
JL67-3-88 670441

Ayers, R. A.
Magnetic pulse forming occurs under the pressure produced by the interaction of a magnetic field and the currents it induces in a workpiece
JL67-7-54 670992

B

Badger, J. P.
Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Baird, J. D.
Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Baker, D. F.
Manufacturing problems call for engineering professionals
JL67-4-52 670755

Bauer, F.
Ford and Bureau of Public Roads are developing systems to improve vehicular communications on the highway
JL67-12-73 671054

Baxter, M. C.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Beach, J. F.
Significant reductions in exhaust emissions can be made by retarding the spark, or by reducing the cylinder quench area
JL67-4-51 670754

Beauvais, F. N.
Quasi-steady-state data from wind tunnel tests are adequate for analysis of car stability in wind gust conditions up to 15-deg yaw angles
JL67-6-66 670793

Bentley, C. W.
Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Bernstein, A. I.
Structural design of reusable horizontal-launch vehicles for manned orbital operations system
JL67-11-40 671040

Billet, A. B.
Aircraft hydraulic parts survive jungle erosive environment. O-rings still pliable and functional
JL67-9-40 671013

Binder, A. M.
Throttle is only moving part in low-cost fluidic carburetor
JL67-8-36 670998

Black R. E.
Noise annoyance of new, larger capacity DC-8 jets should be less, due to lower noise level, fewer exposures to noise, reduced duration of noise
JL67-6-51 670788

Blaich, E. O. A.
Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Blalock, W. S.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Boerma, M.
Carburetors having means to compensate for inlet air pressure and temperature variations would reduce air pollution
JL67-5-42 670770

Bogan, R. F.
Both laboratory and on-the-road tests compare 2- and 4-ply tire performance. 2-ply is found superior in almost all tests
JL67-10-79 671037

Bolt, J. A.
Carburetors having means to compensate for inlet air pressure and temperature variations would reduce air pollution
JL67-5-42 670770

Booy, R. R.
Techniques for indirect measurement of scavenging parameters show promise for evaluating scavenging efficiency
JL67-11-72 671048

Boyce, J. E.
The engineer who would equip himself to be an effective supervisor must: help prepare and use budget information
JL67-1-53 670411

The engineer who would equip himself to be an effective supervisor must: utilize manpower efficiently
JL67-2-69 670420

The engineer who would equip himself to be an effective supervisor must: evaluate employee performance and qualifications
JL67-3-91 670442

The engineer who would equip himself to be an effective supervisor must: make salary and promotion recommendations
JL67-4-56 670757

The engineer who would equip himself to be an effective supervisor must: serve as a communication link
JL67-5-65 670779

The engineer who would equip himself to be an effective supervisor must: counsel with employees
JL67-6-88 670798

The engineer who would equip himself to be an effective supervisor must: encourage employee development
JL67-7-47 670988

The engineer who would equip himself to be an effective supervisor must: develop skill in conducting meetings
JL67-8-45 671001

The engineer who would equip himself to be an effective supervisor must: administer policies and procedures
JL67-9-49 671016

The engineer who would equip himself to be an effective supervisor must: maintain morale and motivation
JL67-10-53 671030

Bradish, J. P.
Engine deposits, expressed in terms of thermal resistance and penetration, showed their adverse effects on performance in laboratory tests
JL67-2-82 670424

Bradley, E. F.
Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Bradow, R. L.
Nitrogen oxides found in spark-ignition engine exhaust are flame-formed
JL67-7-52 670991

Brasier, R. E.
New optical instrument reduces setup times of jig structures and increases accuracy in establishing three mutually perpendicular lines of sight
JL67-4-86 670767

Breitenburger, G.
Criteria given for safe windshield. Of paramount importance is the type of glass and mount: windshield should be made of laminated safety glass, loosely mounted
JL67-12-76 671055

Brichford, T. K.
Two approaches to control of turn signal flasher quality
JL67-3-66 670435

Brink, H. M.
Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Brody, R. P.
Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Brower, D. F.
Magnetic pulse forming occurs under the pressure produced by the interaction of a magnetic field and the currents it induces in a workpiece
JL67-7-54 670992

Brubacher, M. L.
Smoke and smell reduction are major diesel exhaust problems
JL67-9-34 671011

Buckner, H. A., Jr.
Business jet service life is being lengthened with a combination of film and convection cooling for turbine stator and rotor blades
JL67-12-78 671056

Buell, D. N.
Saturn 1B launch vehicle can be uprated to handle missions of the future
JL67-9-76 671022

Bundorf, R. T.
Vehicle understeer and characteristic speed measured by three tests
JL67-11-46 671041

Buning, H.
Quasi-steady-state data from wind tunnel tests are adequate for analysis of car stability in wind gust conditions up to 15-deg yaw angles
JL67-6-66 670793

Burks, G. E.
Ride simulator speeds design studies aimed at operator comfort
JL67-5-54 670776

Burnett, J. E.
Government technology stockpile is now one of country's valuable resources. Practical ways are being focused to make data available to industry
JL67-9-38 671012

Bus, F. J.
Partial-lifting system is optimal control system for large V/STOL transports
JL67-1-54 670412

C

Cubba, T.
Cleaner engines and improved fleet availability follow switch from conventional to long-life oils in Montreal police car fleet
JL67-5-46 670772

Carey, A. W.
Smoke and smell reduction are major diesel exhaust problems
JL67-9-34 671011

Carlsten, E. E.
Techniques planned to minimize time required on Boeing supersonic transport for unscheduled maintenance
JL67-7-46 670987

Cashman, W. D.
World's largest two-axle trucks have radical design differences in frames, transmissions, and braking
JL67-5-52 670775

Chesebrough, H. E.
Car occupant restraint system should require no overt action by user
JL67-10-45 671028

Clark, J. M., Jr.
Jeep engine gets stratified charge combustion
JL67-4-63 670759

Clark, S. K.
Occasional overloads cause bolt loosening
JL67-8-64 671006

Connors, J. F.
Self-motivation is key element in continuing education success
JL67-2-80 670423

Myths about engineers block individual progress
JL67-4-71 670761

Cook, J. J.
Occasional overloads cause bolt loosening
JL67-8-64 671006

Cordon, F. R.
Constant-speed-drive generating systems keep pace with aircraft
JL67-2-48 670416

Cornish, R. F.
Simple procedure sets end play in tapered bearings. It is suitable for assembly line or field service use, and requires only common tools
JL67-4-78 670764

Cunningham, R. G.
Three new glass-reinforced plastics are available in sheet form, ready for molding. Matched-die molding operations can be used
JL67-12-80 671057

D

Daniel, W. A.
Concentration shifts of the total or a particular exhaust emission may not reflect, even in direction, concentration shifts of other emission constituents
JL67-11-58 671045

Daniels, C. J.
Proposed assisted take-off and landing system may make in-city airports a reality
JL67-8-39 670999

Deibel, W. T.
400-bhp engines will be common on trucks in five years, and matching transmissions to them may be more difficult than before
JL67-8-43 671000

Dellape, M. J.
Improved reporting is giving top management the brief, factual, financially oriented information needed to make sound decisions promptly
JL67-3-88 670441

DeLuca, F.
Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

Denke, P. H.
Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Dickman, G. J.
Three Titan III launch vehicles are versatile space performers
JL67-6-84 670206

Diello, W.
D-c variable-speed motor has superior performance, decreased size and cost. Initial use is as windshield wiper motor
JL67-5-76 670783

Dixon, R.
Titanium is being readied for major role in SST design
JL67-6-78 670795

Four possible parking arrangements for the Boeing SST
JL67-11-50 671043

Dobie, W. J.
Both laboratory and on-the-road tests compare 2- and 4-ply tire performance. 2-ply is found superior in almost all tests
JL67-10-79 671037

Dolliver, D. M.
Partial-lifting system is optimal control system for large V/STOL transports
JL67-1-54 670412

Donachie, M. J., Jr.
Miniature airfoils test thermal fatigue of aircraft gas turbine alloys
JL67-2-90 670427

Douglas, D. A., Jr.
Government technology stockpile is now one of country's valuable resources. Practical ways are being focused to make data available to industry
JL67-9-38 671012

Driscoll, N. R.
Pilots not qualified to fly with instruments perform well in light aircraft if they use a wings-leveling device in instrument weather
JL67-5-82 670786

Dunlop, D. R.
Two approaches to control of turn signal flasher quality
JL67-3-66 670435

E

Eaton, W. C.
Brake response in passenger cars and trucks improves when brake proportioning valves adjust brakes for dynamic and static loading
JL67-9-58 671019

Eddy, R. T., Sr.
Brake Response in passenger cars and trucks improves when brake proportioning valves adjust brakes for dynamic and static loading
JL67-9-58 671019

Eden, J. J.
Gap between achieved life and design life of gas turbine components can be narrowed. Practical approach can bring large cost savings
JL67-2-94 670428

Emery, R.
Ford and Bureau of Public Roads are developing systems to improve vehicular communications on the highway
JL67-12-73 671054

F

Finch, D. M.
Two approaches to control of turn signal flasher quality
JL67-3-66 670435

Fleming, C. L.
Hydraulic skooper dump cylinder failures due to surge pressure and mechanical bumping are eliminated by cylinder with an external cushion
JL67-10-69 671035

French, C. C. J., Sr.
Smoke and smell reduction are major diesel exhaust problems
JL67-9-34 671011

Fulton, J. L.
Restraints used in Los Angeles police cars include seat belt and double shoulder straps—plus crash helmets
JL67-8-86 671010

G

Galen, C. W.
Fuel factors producing corrosion can be identified and corrosion life of valve alloys measured by drilled-hole engine-mounted test
JL67-1-43 670408

Gallagher, J. E.
Secondary surveillance radar proves a boon to controlling helicopter traffic near airports
JL67-3-92 670443

Gannett, J. R.
Titanium is being readied for major role in SST design
JL67-6-78 670795

Four possible parking arrangements for the Boeing SST
JL67-11-50 671043

Garry, F. W.
Business jet service life is being lengthened with a combination of film and convection cooling for turbine stator and rotor blades
JL67-12-78 671056

Gerus, T. F.
Bending moment on Atlas booster tank is increased 50% after wrinkling first occurs in this large thin-walled cylinder
JL67-12-60 671052

Goff, R. L.
Hydrostatic power steering system opens new era in controllability
JL67-4-54 670756

Goodwin, M. C.
New apparatus measures friction characteristics of controlled-slip differential lubricants
JL67-9-66 671020

Gow, D. W.
Reducing the oil concentration in fuel for 2-stroke-cycle engines has marked advantages, but careful formulation of the oil is necessary
JL67-6-59 670790

Graiff, L. B.
Engine tests show that red lead oxide with distorted tetragonal structure is most active antiknock of tel decomposition products
JL67-8-55 671004

Gray, R. W.
Manual testing is still needed in many space programs
JL67-3-100 670446

Gross, W.
Calculated main bearing forces in multicylinder engines are closer to those measured in tests when crankshaft is assumed elastically supported
JL67-11-76 671049

H

Hanchett, H. K.
Fourteen elements are significant in customer attitude on ground support equipment
JL67-6-80 670796

Hanson, H. L.
Driver's chances of survival in head-on crashes improve with energy-absorbing steering column
JL67-10-36 671025

Hanysz, E. A.
Unified communication system promises safer driving
JL67-5-36 670769

Harris, W. L.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Hassan, W. T. F.
It is the small power gains that win Grand Prix races
JL67-10-72 671036

Two V-8 engine crankshafts fitted to central drive gear form crankshaft for Coventry Climax Flat-16 engine
JL67-11-49 671042

Early Coventry engines were losing races due to oil churning, overheating, ignition failure, and fuel blockage, rather than lack of power
JL67-12-84 671058

Haviland, M. L.
New apparatus measures friction characteristics of controlled-slip differential lubricants
JL67-9-66 671020

Haxby, L. P.
Thermal stability of jet fuel can be maintained from refinery to aircraft
JL67-7-48 670989

Heil, W. H.
Titanium is being readied for major role in SST design
JL67-6-78 670795

Helfrich, W. E.
Protective coatings help to extend jet engine part life
JL67-3-78 670438

Henderson, B. M.
Laboratory antirust oil test results checked in 4000 miles of field testing
JL67-3-81 670439

Hogue, W. M.
Computers speed body engineering
JL67-6-56 670789

Holzhausen, G.
Turbochargers will get smaller, more reliable, and more efficient
JL67-2-68 670419

Hucker, D. J.
Constant-speed-drive generating systems keep pace with aircraft
JL67-2-48 670416

Hudgens, B. C.
Hydrostatic power steering system opens new era in controllability
JL67-4-54 670756

Hudson, A. C.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Hummel, J. W.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Hunt, R. T.
Titanium alloys look best for Mach 3 transport aircraft, but crack stoppers are also needed to prevent crack growth to catastrophic failure
JL67-1-36 670407

Hussmann, A. W.
Calculated main bearing forces in multicylinder engines are closer to those measured in tests when crankshaft is assumed elastically supported
JL67-11-76 671049

I

Isringhaus, E. A., Jr.
Laboratory antirust oil test results checked in 4000 miles of field testing
JL67-3-81 670439

J

Jensen H. O.
Future tractor and earthmover aim for increased productivity
JL67-9-90 671024

Joe, C. Y.
A seating capacity of 500 will be needed to produce a 20% drop in direct operating costs, compared with today's large jets
JL67-3-70 670436

Johnson, R. W.
Improved reporting is giving top manage-

ment the brief, factual, financially oriented information needed to make sound decisions promptly
JL67-3-88 670441

Johnson, V. A.
Fuel factors producing corrosion can be identified and corrosion life of valve alloys measured by drilled-hole engine-mounted test
JL67-1-43 670408

Johnson, W. L.
Computer defines and shapes complex surfaces. A complete but simplified car body has been designed and displayed in three dimensions
JL67-7-66 670995

Jones, K. J.
Different intensity day and night turn signals, improved headlight low beam for turnpike driving stir attention in Europe
JL67-11-36 671039

Jones. W. W.
Business jet service life is being lengthened with a combination of film and convection cooling for turbine stator and rotor blades
JL67-12-78 671056

K

Kaelin, G. H.
Adapting electroluminescent lighting to Apollo instrument panel posed problems of lamp brightness and color and high temperature
JL67-8-51 671003

Kahle, G. W.
Gas turbines promise profits for off-highway vehicle users
JL67-2-70 670421

Kay, R. E.
New remote controlled valve simplifies vehicle hydraulic systems
JL67-3-63 670434

Keinath, R. L.
Chevrolet's V-8 "Turbo-Jet" passenger car engine was designed primarily to increase volumetric efficiency
JL67-8-66 671007

Kluckner, A. R.
Eight steps to successful decisionmaking
JL67-1-60 670413

Kroell, C. K.
Cornell Aeronautical Laboratory Computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Kueser, P. E.
Best electrical materials for use between 600 and 1600 F are studied
JL67-6-89 670799

Kuivanen, G. J.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Kulose, H. B.
Fuel fired heater provides instant interior warmth and warmer cold starting
JL67-3-98 670445

Kummer, H. W.
Unified theory of rubber friction reveals role of adhesion component in tire-road surface coupling
JL67-8-70 671008

L

Laile, R. W.
Pontiac uses four parallel lines with manual and automatic stations intermixed to improve quality and reduce manpower in the assembly of differential units
JL67-5-48 670733

Larsen, R. T.
Dynamic versus static spring rates for vibration mounts. Dynamic spring rate dependent on four variables. Two dynamic test methods described
JL67-11-80 671050

Lawler, G. F.
Thermal stability of jet fuel can be maintained from refinery to aircraft
JL67-7-48 670989

Leamon, J. F.
Goal of in-service development is more and faster repair to extend jet-engine component life and reduce maintenance cost
JL67-6-62 670791

Leslie, W. B.
Three Titan III launch vehicles are versatile space performers
JL67-6-84 670206

Lien, D. G.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Linville, W.
Significant reductions in exhaust emissions can be made by retarding the spark, or by reducing the cyliner quench area
JL67-4-51 670754

Litchford, G.
Secondary surveillance radar proves a boon to controlling helicopter traffic near airports
JL67-3-92 670443

Little, R. N.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Lollar, T. E.
Partial-lifting system is optimal control system for large V/STOL transports
JL67-1-54 670412

Lowry, J.
1967 European cars show changing trends
JL67-2-36 670415

Ludwig, A. L.
Thermal stability of jet fuel can be maintained from refinery to aircraft
JL67-7-48 670989

Lundeberg, J. F.
Penetrating study of meteoroid barriers for spacecraft
JL67-5-68 670781

Lundstrom, L. C.
Restraint systems promise substantial crash protection
JL67-4-58 670758

M

MacRostie, J. J.
Shock, vibration, ride dynamics and suspension are main factors in ground missile-carrier design
JL67-7-56 670993

Malott, T. J.
Demand valve switches flow from steering to implement circuits in articulated vehicle
JL67-9-42 671014

Mangelkamp, R. A.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Marquis, D. P.
Driver's chances of survival in head-on crashes improve with energy-absorbing steering column
JL67-10-36 671025

Matzenauer, J. O.
In next ten years, either direct or rendezvous mode will be used for each moon-mission. Rendezvous type costs more but can carry more men
JL67-4-38 670752

McHenry, R. R.
Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Meade, R. A.
Plastic fiber optics materials are being used in various lighting and remote-indicating systems on some of the 1967 cars
JL67-12-67 671053

Mertz, H. J., Jr.
Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Meyer, W. A. P.
Tests on four compact cars prove that lowering oil viscosity and increasing fuel vapor pressure ease cold starting problems
JL67-10-62 671033

Meyer, W. E.
Unified theory of rubber friction reveals role of adhesion component in tire-road surface coupling
JL67-8-70 671008

Michelson, C. E.
Cathodic and anodic actions affect CASS test response of anodized aluminum
JL67-4-75 670763

Miller, A. E.
Oxygen cylinders may pass out of the picture in favor of newer methods of oxygen storage and distribution in aircraft
JL67-5-50 670774

Miller, R. P.
Bending moment on Atlas Booster tank is increased 50% after wrinkling first occurs in this large thin-walled cylinder
JL67-12-60 671052

Millington, W. B.
Smoke and smell reduction are major diesel exhaust problems
JL67-9-34 671011

Milner, F.
An engineer from Viet Nam tells about the hydraulic system problems that come from neglecting small things, and failures due to poor quality control
JL67-1-47 670409

Montogmery, D. C.
Cathodic and anodic actions affect CASS test response of anodized aluminum
JL67-4-75 670763

Montgomery, R. D.
Moisture-proofing car window lift motors
JL67-3-96 670444

Moon, C. L.
Tailoring the truck cooling system to new engine requirements can pay dividends in increased vehicle reliability and life
JL67-1-62 670414

Moon, J. W.
Value engineering pays off. Two-word problem definitions and placing monetary values on performance are essentials
JL67-2-84 670425

Moorehead, J. R.
Controls that adjust the variable geometry air inlet of the supersonic transport are vital to successful supersonic flight
JL67-10-54 671031

Morse, R. J.
Brake response in passenger cars and trucks improves when brake proportioning valves adjust brakes for dynamic and static loading
JL67-9-58 671019

Mosher, R. S.
New concept joins man and machine to perform gigantic tasks. Application will be to earthmoving and materials handling
JL67-9-72 671021

Murray, J. W.
Two approaches to control of turn signal flasher quality
JL67-3-66 670435

Myers, P. S.
Engine deposits, expressed in terms of thermal resistance and penetration, showed their adverse effects on performance in laboratory tests
JL67-2-82 670424

N

Naab, K. N.
Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Newhall, H. K.
Ammonia and hydrocarbons theoretically compared as turbine fuels on basis of power output, thermal efficiency, and fuel economy
JL67-6-71 670794

O

Oberdorfer, P. E.
Concentration shifts of the total or a particular exhaust emission may not reflect, even in direction, concentration shifts of other emission constituents
JL67-11-58 671045

Oglesby, R. C.
Plexiglas H is acrylic plastic for higher temperature service in automotive signal lenses
JL67-2-86 670426

Rohm & Haas Explorer IV car demonstrates new automotive uses for acrylics
JL67-6-64 670792

Orlando, D.
Through partition cell connector increases battery starting power
JL67-4-68 670760

Oswald, T.
Through partition cell connector increases battery starting power
JL67-4-68 670760

P

Parker, E. L.
Diesels must lose weight to find marine powerplant usage. Research continues to satisfy Coast Guard needs
JL67-5-78 670784

Pascoe, G.
Computers speed body engineering
JL67-6-56 670789

Paterson, S., Jr.
Nicrosil and HH alloys selected for hot sizing dies are cast in modified Shaw Process molds to form titanium parts at temperatures up to 1450 F
JL67-7-63 670994

Patrick, L. M.
Cornell Aeronautical Laboratory computer simulation predicts occupant responses during vehicle head-on collision
JL67-7-36 670986

Patton, W. G.
1968 passenger cars feature cleaner exhaust and many safety features
JL67-12-36 671051

Perry, D. S.
D-c variable-speed motor has superior performance, decreased size and cost. Initial use is as windshield wiper motor
JL67-5-76 670783

Phillips, N.P.
Use of nonmetallic materials—plastics, glass, rubber, organic coatings, and so forth—expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

Phillips, S. R.
Fan-heater circulates and heats cryogenic oxygen for space duty
JL67-2-64 670418

Pierson, O. L.
Plexiglas H is acrylic plastic for higher temperature service in automotive signal lenses
JL67-2-86 670426

Platt, M.
1967 European cars show changing trends
JL67-2-36 670415

Polkinghorne, W. J.
Chevrolet's V-8 "Turbo-Jet" passenger car engine was designed primarily to increase volumetric efficiency
JL67-8-66 671007

Porter, R.D.
Controls that adjust the variable geometry air inlet of the supersonic transport are vital to successful supersonic flight
JL67-10-54 671031

Pratt, J. T.
Goal of in-service development is more and faster repair to extend jet-engine component life and reduce maintenance cost
JL67-6-62 670791

Price, M. A.
Structural design of reusable horizontal-

launch vehicles for manned orbital operations system
JL67-11-40 671040

Priceman, S.

New protective coatings allow use of columbium and tantalum alloys in reusable reentry vehicles despite their poor oxidation resistance
JL67-10-46 671029

Purdy, J. A.

D-c variable-speed motor has superior performance, decreased size and cost. Initial use is as windshield wiper motor
JL67-5-76 670783

R

Raines, I. I.

Self-motivation is key element in continuing education success
JL67-2-80 670423

Myths about engineers block individual progress
JL67-4-71 670761

Raymond, L.

Corrosion and radiation effects must be minimized in fuels for automotive turbine engines
JL67-7-69 670996

Reasbeck, P.

Gaining better performance for smaller batteries
JL67-5-75 670782

Redmond, G. H.

Chrysler uses computer data processing to record history of each car, pay legitimate claims, and follow up on questionable ones
JL67-2-77 670422

Reeves, L. L.

Cleaner engines and improved fleet availability follow switch from conventional to long-life oils in Montreal police car fleet
JL67-5-46 670772

Rodgers, J. J.

New apparatus measures friction characteristics of controlled-slip differential lubricants
JL67-9-66 671020

Rodloff, G.

Criteria given for safe windshield. Of paramount importance is the type of glass and mount: windshield should be made of laminated safety glass, loosely mounted
JL67-12-76 671055

Roper, R. E.

Stretch-forming preformed sleeves into parts saves materials. Equipment and tooling costs compare favorably with those for metal drawing
JL67-3-54 670431

S

Sabatino, A.

Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Sama, L.

New protective coatings allow use of columbium and tantalum alloys in reusable reentry vehicles despite their poor oxidation resistance
JL67-10-46 671029

Sanders, J. W.

Computer defines and shapes complex surfaces. A complete but simplified car body has been designed and displayed in three dimensions
JL67-7-66 670995

Schagrin, E. B.

Automatic stability augmentation system integral with Boeing H-46 flight control system ensures good stability without an autopilot
JL67-10-64 671034

Schairer, G. S.

Operation of aircraft under instrument flying rules at all times would practically eliminate navigational accidents
JL67-12-86 671059

Schmidt, R. C.

Smoke and smell reduction are major diesel exhaust problems
JL67-9-34 671011

Diesel cylinder design is not compromised when certain cylinders are used as air compressors to unload bulk cargo
JL67-9-55 671018

Schnyder, A. S.

Saturn IB launch vehicle can be uprated to handle missions of the future
JL67-9-76 671022

Schreur, I.

Brake response in passenger cars and trucks improves when brake proportioning valves adjust brakes for dynamic and static loading
JL67-9-58 671019

Schweitzer, P. H.

Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

Searls, F.

A seating capacity of 500 will be needed to produce a 20% drop in direct operating costs, compared with today's large jets
JL67-3-70 670436

Severy, D. M.

Full-scale collision experiments provide the basis for correcting school-bus safety deficiencies
JL67-11-62 671046

Shidle, N. G.

Review of Interim Report of Committee on Goals of Engineering Educaton indicates its chances of widespread acceptance are good
JL67-10-60 671032

Shilkoff, M. J.

Rail travel is about to be changed by lightweight, streamlined, high-speed trains designed for passenger comfort
JL67-6-40 670787

French Aerotrain, which rides on air cushion, and jet-powered New York Central train have gone over 180 mph
JL67-7-74 670997

Japanese National Railroads and Pennsylvania is getting a high-speed electric train with self-propelled railcars
JL67-8-74 671009

Shirk, R. W.

Car body aerodynamics play an important role in heater airflow
JL67-9-50 671017

Shonyo, H. N.

Adapting electroluminescent lighting to Apollo instrument panel posed problems of lamp brightness and color and high temperature
JL67-8-51 671003

Sidelko, W. J.

Six guidelines to help engineers design highway truck tractor frames
JL67-2-50 670417

Siebel, M. P. L.

Manufacturing problems call for engineering professionals
JL67-4-52 670755

Skeels, P. C.

Driver's chances of survival in head-on crashes improve with energy-absorbing steering column
JL67-10-36 671025

Smith, A. H.

Five new carbon steels have been inserted between SAE 1026 and 1027 to fill the gap in hardenability range
JL67-4-84 670766

Smith, G. R.

Two approaches to control of turn signal flasher quality
JL67-3-66 670435

Smith, L. H.

Flight operations from a circular runway are feasible
JL67-3-56 670432

Sneyd, J. M.
Increased design complexity yields to automated design with aid of digital computer
JL67-10-43 671026

Sood, H. G.
Chevrolet's V-8 "Turbo-Jet" passenger car engine was designed primarily to increase volumetric efficiency
JL67-8-66 671007

South, N. E.
Computer defines and shapes complex surfaces. A complete but simplified car body has been designed and displayed in three dimensions
JL67-7-66 670995

Spencer, A. R., Sr.
Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

Spetta, D. A.
Manufacturing problems call for engineering professionals
JL67-4-52 670755

Spurgeon, W. M.
Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

Starkman, E. S.
Various component gases of engine generated pollution pose differing health hazards
JL67-3-85 670440

Ammonia and hydrocarbons theoretically compared as turbine fuels on basis of power output, thermal efficiency, and fuel economy
JL67-6-71 670794

Stern, A. C.
Acute pollution problems still face automotive engineers
JL67-11-69 671047

Stewart, R. M.
Tests on four compact cars prove that lowering oil viscosity and increasing fuel vapor pressure ease cold starting problems
JL67-10-62 671033

Stotter, A.
Test rig measures heat transfer of various piston cooling methods
JL67-9-47 671015

Stransky, P. D.
Cathodic and anodic actions affect CASS test response of anodized aluminum
JL67-4-75 670763

Strigle, C. E.
Reliable tire monitoring systems are too costly; low-cost systems are unreliable. All systems lack flexibility for trailer interchange
JL67-5-66 670780

Swan, F. F.
Manufacturing problems call for engineering professionals
JL67-4-52 670755

T

Tanquary, E. W.
Shielding is important part of farm machinery safety but other factors are vital, too
JL67-4-88 670768

Tiffan, A. J.
Three new glass-reinforced plastics are available in sheet form, ready for molding. Matched-die molding operations can be used
JL67-12-80 671057

Trautman, C. E.
Reducing the oil concentration in fuel for 2-stroke-cycle engines has marked advantages, but careful formulation of the oil is necessary
JL67-6-59 670790

Tweedy, R. H.
A single tractor which executes the farm tasks now performed by a variety of units, and a self-propelled flat-bed farm wagon, is proposed
JL67-9-83 671023

Twiss, S. B.
Use of nonmetallic materials—plastics, glass, rubber, organic coatings, and so forth–expected to rise sharply in passenger cars in next 20 years
JL67-10-82 671038

U

Umberger, C. C.
Four Army vehicles–drum, drum-belt, track, and track-pontoon–which have been designed to traverse soft soil and watery areas, show promise under test
JL67-7-50 670990

Uyehara, O. A.
Engine deposits, expressed in terms of thermal resistance and penetration, showed their adverse effects on performance in laboratory tests
JL67-2-82 670424

V

Van Nimwegen, R. R.
Business jet service life is being lengthened with a combination of film and convection cooling for turbine stator and rotor blades
JL67-12-78 671056

Van Ostrom, D. L.
Vapor pressure comparator will operate satisfactorily under abnormal conditions
JL67-5-80 670785

Varga, T. J.
Better battery construction, electrical systems, and battery environment are lengthening battery life
JL67-3-72 670437

Vaverek, J. C.
Large chassis dynamometer tests of tractor-trailer reveal ways to improve tractor-cab ride
JL67-3-60 670433

Victor, I. W.
Jet engine in high-speed stall can stall other engines in cluster
JL67-3-48 670430

Volz, C.
Electronic feedback control gives continuous engine tune-up for best power and fuel economy
JL67-1-48 670410

W

Waker, C.
Effect of cylinder and exhaust system modifications on the performance of 2-stroke-cycle engines
JL67-4-43 670753

Walton, J. P.
Three new glass-reinforced plastics are available in sheet form, ready for molding. Matched-die molding operations can be used
JL67-12-80 671057

Waters, J. A., Jr.
Three new glass-reinforced plastics are available in sheet form, ready for molding. Matched-die molding operations can be used
JL67-12-80 671057

Webster, F. M.
Chrysler uses computer data processing to record history of each car, pay legitimate claims, and follow up on questionable ones
JL67-2-77 670422

Ground rules for success as a manager
JL67-10-44 671027

Welsh, H. W.
Otto- and diesel-cycle-engines will remain dominant mobile powerplants in next 10–25 years; later, fuel cell and battery will emerge
JL67-8-60 671005

Westra, R. O.
Liquefied petroleum gas shows superiority over gasoline as an engine fuel
JL67-11-52 671044

Westveer, R. C.
Demand valve switches flow from steering to implement circuits in articulated vehicle
JL67-9-42 671014

Wheelwright, C. D.

Adapting electroluminescent lighting to Apollo instrument panel posed problems of lamp brightness and color and high temperature
JL67-8-51 671003

Wilkinson, W. H., Jr.

Satellite concept of superairport separates aircraft from ground operations. Rapid transit system eliminates distance restrictions
JL67-6-82 670797

Williams, P. L.

Fourteen elements are significant in customer attitude on ground support equipment
JL67-6-80 670796

Wilson, R. A.

Brake response in passenger cars and trucks improves when brake proportioning valves adjust brakes for dynamic and static loading
JL67-9-58 671019

Winge, J. L.

Four tests: radiography, resinography, thermal analysis, and a modified version of SAE J661 drag test ensure brake lining consistency
JL67-8-46 671002

Wise, H. L.

Self-rectifying automotive-type alternators save weight, reduce expense, simplify controls, give more output at lower speeds on light aircraft
JL67-4-72 670762

Witter, R. W.

Diesels must lose weight to find marine powerplant usage. Research continues to satisfy Coast Guard needs
JL67-5-78 670784

Witzky, J. E.

Jeep engine gets stratified charge combustion
JL67-4-63 670759

Z

Ziegenfelder, R. F.

Satellite concept of superairport separates aircraft from ground operations. Rapid transit system eliminates distance restrictions
JL67-6-82 670797

1967 SAE JOURNAL INDEX

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